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PROPOSED INTERNATIONAL CANDLE.

We learn that a joint committee of the Gas Institute, of the Institution of Electrical Engineers, and of the Illuminating Engineering Society has recently drawn up resolutions urging the National Bureau of Standards at Washington to take steps toward bringing about, if possible, an international candle corresponding, say, to a readjusted *bougie decimale*, which should be acceptable to Belgium, Denmark, England, France, Holland, Italy, Norway, Sweden and the United States. Such an international candle might well be established through the medium of interchanged standardized incandescent lamps, on the basis of mean values of, say, the British pentane candle, the French carcel and the older British sperm candle as previously evaluated in terms of the hefner and hitherto employed in this country. The compromise would involve not more than 3 per cent change in any of the standards now existing, and would abolish the senseless multiplication of primary national photometric units. According to the views of the joint committee above referred to, which views we cordially endorse, the illuminating engineering industries are ready to change their existing United States standards of candle-power if the countries named, or the majority of them, will agree upon a common compromise international candle. We hope that the United States Bureau of Standards will lose no time in soliciting the aid of all the other countries in bringing about this much-to-be-desired result. It would be very desirable to include Germany in the plan, but the hefner unit used in Germany is some 10 per cent off the mean candle of other countries, and no one can be expected to make so great a change as that unit would involve industrially if universally accepted. However, the agreement of the countries not using the hefner upon an international candle, would at least reduce six existing standards to two. Each country would then have its own national standard, the pentane, carcel, hefner, etc., and also one international candle, maintained by lamp interchange and in known relation to the national lamp. At present, with six national standards, we have to keep a sort of cross-reference table with 36 entries in order to compare results. In time, the international candle might make reference to each special national standard unnecessary.

THE BELL TELEPHONE REPORT.

Some very interesting statistics are given in President Vail's annual report for the American Telephone & Telegraph Company's system. A total capitalization for the system is shown of $554,939,000, with an appraisal value for the plants of $488,296,000. This leaves barely $75,000,000 for good-will, franchises, contracts, etc., so that a physical valuation would have no terrors. A great deal of nonsense has been uttered and written about Bell over-capitalization, but such figures are one of the best evidences that could be adduced as to the inherent financial soundness of the enterprise. This great system brought in last year $120,753,200 in net earnings. An estimate at the beginning of the year was $200,000,000 for the Bell and Independent networks together, and would appear to be

quite exact. Incidentally we may note that President Lindemuth, of the International Association, places the Independent capitalization at $350,000,000, which, for the whole industry, would make a splendid total of $900,000,000. This is very near the amount estimated for the central-station industry, namely, $1,000,000,000, and shows how rapidly the telephone art is coming up to the levels of lighting and traction as a field of investment.

An interesting item in the report is the statement that the Bell system now has 3,035,533 stations. The Independents claim 4,000,000. But the Bell system has connected with it 755,316 Independent stations and private lines, making a total of 3,839,000, so that the two systems on this basis of computation are fairly equal. There being no reason to question Mr. Vail's figures, it would seem that actually not far short of 20 per cent of the Independent instruments are on working terms with the Bell system, in spite of the anathemas and bulls of excommunication directed against those who indulge in this unholy practice. On the other hand, the virtues of competition are clearly brought out by these figures of growth, although Mr. Vail addresses himself very earnestly to an argument on the proposition that the old theory "the telephone is a natural monopoly" is still tenable. If it be true that existing competitive local systems overlap only to the extent of about 15 per cent, the theory needs restating in some other form. When the actual point of saturation has been reached in telephonic development, the theory may quite likely validate itself, but meantime it does look as though the public were benefiting by the existing struggle and that even the Bell system was none the worse for having had to justify its existence by dealing with a strong adversary in a field in which it once reigned supreme.

The Kennelly Diagram.

The new method of determining mean spherical or zonal intensities from the polar curve of a luminous source, described by Dr. Kennelly this week, is of great interest and practical convenience. It is less obvious but more elegant than the familiar Rousseau diagram, and more useful in that in the final result it substitutes a linear measurement for the determination of an irregular area. This of itself is an important improvement, since the summation of the area under a curve is no small bother by whatever method accomplished. Even getting out and working a planimeter is a nuisance unless a number of results are to be evaluated at the same time. When the Kennelly diagram is drawn the work is practically over, while when the Rousseau diagram is drawn the trouble is just fairly under way. Both diagrams are methods of approximate graphical integration and their accuracy depends upon the number of zones taken for the summation. From the figures given by Dr. Kennelly the use of 10 deg. zones is beyond the necessities of ordinary commercial photometry, 15 deg. or 20 deg. zones being quite sufficient for most cases. Zonal values can be scaled off with great readiness just as they can be determined by the planimeter from the Rousseau diagram. Dr. Kennelly's discovery of this new and beautiful method comes at a most opportune time before the Rousseau method has rooted itself in American practice. It is used, of course, and appreciated, but the only diagram familiar to the average student or engineer is the usual polar one. This, convenient as it is, has serious limitations, and often conveys at a glance information that a little study shows to be entirely incorrect. For instance, a really considerable equatorial distribution of light may be represented by a mere inconsequential hump on the polar curve of a concentrating shade, while on the other hand an immense polar extension may really represent a very modest flux of light. The Kennelly diagram makes no false representations of this kind, and while it is less easily read by the untrained eye than the areas of the Rousseau curve, it is much more easily constructed by the student or the engineer, and quite as serviceable for technical purposes. It is certainly a most valuable addition to the armory of the engineer and we shall hope to see it come into immediate and extensive use. We congratulate Dr. Kennelly on the development of a method so novel and so beautifully facile.

The Tungsten Lamp Situation.

From the standpoint of the electrical supply company the evolution of the new incandescents is at an embarrassingly rapid rate, not by any serious lessening of output, but by the incidental questions of policy and the demand for things which are not obtainable. Broadly, every improvement in efficiency is desirable and in the long run will increase earnings, and central station men realize this fully. Yet when a lamp comes along that is actually able to reduce by two-thirds the consumption of energy per candle-power, it is a little difficult to tell what had best be done with it in view of a limited supply and a high price. In particular the latter feature of the new lamps is troublesome to the companies that have been furnishing free lamp renewals. While on account of the long effective life of the tungsten lamps and their high efficiency, the actual cost of renewals per cp-hour is little more than in the case of carbon lamps even at present prices for the former, the fact is that per kilowatt sold through them the renewals are equivalent to a substantial cut in price, say 10 per cent or more. In other words, a company that furnishes free renewals of tungsten lamps not only cuts its immediate sales, but its price as well.

On the other hand, it has been the quite uniform experience that a cut in price of current made spontaneously and not forced by cut-throat competition, has been followed by a positive increase of business and profits. The world is yearly getting more nocturnal in its habits and is needing and using more and more light. And its use of electricity for lighting seems to have steadily increased faster than the price has decreased. The final result therefore of the new high-efficiency lamps will be increased earnings. Yet at present the situation is such that free renewal of such lamps is a difficult matter. The lamp factories cannot now or in the immediate future turn out tungsten lamps fast enough to meet even a fraction of the demand; and when a company cannot get enough lamps to supply its customers how shall it square itself with disappointed customers if it undertakes free renewals? It cannot give each customer his proportionate share of the obtainable lamps, for a mixture of carbon and tungsten lamps is not only of objectionable appearance, but would be productive of unlimited kicking. It cannot properly distribute tungsten lamps by a lottery system nor can it fairly discriminate between customers. The logical procedure seems to be that adopted by most supply companies, of charging enough for renewals to put it fairly up to the consumer as to changing his installation. Enterprising men who realize the economics of the situation will then change over to the new lamps as fast as they can be had, while the obtuse or over-conservative will pay, as always hap-

pens, for their lack of enterprise. Then the question of free renewals, i. e., cutting price, can be left to take care of itself in due season.

The early crop of lamps in this country has been mainly in the 100-watt size; that is, of a size well adapted to replace arcs and clusters. But it has fortunately turned out that the smaller sizes are easier to make than seemed possible at first. The slender filaments are somewhat fragile, it is true, but yet less so than was at first to be feared. As a result 60 and 40-watt lamps are on the market in small quantities and a 25-watt lamp is being imported and must be reckoned with later. These smaller lamps touch a vastly greater number of consumers than the larger size, and will be for the present more difficult to supply in quantity. Their renewal costs are materially greater at present prices than those of the larger lamps, and free renewals imply a still larger cut in price. In fact, it is the cost of renewals in these smaller lamps that make the free-renewal problem so troublesome. No one knows, of course, what will be the ultimate cost of the modern high-efficiency lamps. The tendency of price will be assuredly downward, but toward what limit it is difficult to say. Their construction is much more intricate and troublesome than that of carbon lamps, and only experience can show how cheaply it can be carried out. It is, of course, possible that a new material for filaments may turn up of higher specific resistance than tungsten and hence lead to a cheaper and simpler construction. But until such a material is found costs will be relatively high. Tungsten filament is expensive and tantalum, whether for filaments or for supports for the tungsten, is by considerable the most costly commercial metal. Until the situation is relieved and tungsten lamps are available in the enormous quantities required to supply the general demands, central stations have a good many difficulties to face. They cannot fairly be asked virtually to cut the price just because a lamp can be had that will cut their bills in two. Meanwhile the tungsten lamp is being cried for, not only on account of its saving in energy, but by reason of its excellent color, a much closer approximation to white than most arcs, and immeasurably superior to the commoner illuminants.

ARCHITECTURE AND ILLUMINATION.

A recent paper on the relation between the principles of architecture and illuminating engineering brings very forcibly to mind the radical difference in point of view between the artist and the man of affairs—between those whose first demand is æsthetic effect and those who hold to the Socratic doctrine that beauty is adaptability to use. Each represents a somewhat extreme point of view, and reconciliation can be effected only through some measures of compromise. Canons of beauty are the result not of philosophical evolution, but of fashion and environment. The mediæval architect spurned the Greek and Roman ideals in the West and followed them in the East. The modern is glad to copy from any of his forerunners that do not chance at the moment to be out of fashion. As a copyist he is generally fairly successful, and his only really dismal failures come when there are no suitable ancient precedents and he has to strike out for himself. Now and then he scores a notable success, but it is notorious that no group of architects could be found to give unanimous approval to any structure that breaks away from tradition, and on which judgment has to be passed upon its merits rather than its resemblances.

The fundamental conditions between the conditions of ancient and modern architecture lie in the differences of purpose. The great buildings of olden times were, for the most part, of religious significance, or, in later times, colossal compromises between fortresses and buildings. In either case they stood apart in reverence or menace, and their claims to beauty lie in part in their suitable environment. One could hardly appreciate the Parthenon sandwiched between department stores on West Twenty-Third Street, or Notre Dame jammed among the apartment houses of upper Broadway. The great building devoted to strictly utilitarian purposes is distinctively modern, and if it fails of the purposes of its use, no decorative features can redeem it. And illumination, too, is strictly modern. The ancient city was dark after nightfall, and the hours of human labor were adjusted to daylight. At present cities are becoming nocturnal in their ways, and require light not only for purposes of utility, but as part of their natural life. A city building must be judged artistically not only by day, but by night, and designed accordingly. It may be true that this condition of things is all wrong, that men would be better, and be happier, if they worked only in daylight hours, and in the evening left the cliff dwellings of the city for the simpler life, but we cannot escape our environment in this work-a-day world and must face life as we find it. Proper illumination of buildings to be used at night is not primarily a question of æsthetics, but of grim necessity. The building must be suitably lighted by night, and in parts by day, through the use of artificial illuminants. And the architect must never forget that the lighting is essentially not decorative, but utilitarian.

Granted, however, that the illumination is good for the purposes of its use, every one will rejoice if it can be made æsthetically good as well. Just here is the point of contact between the architect and the illuminating engineer. The training of the architect has not yet covered the technique of modern methods of illumination, which is almost daily becoming more intricate, and in the growing tendency to specialization he is never likely to cover it. The illuminating engineer, on the other hand, is not likely to become a specialist in architecture. Working hand in hand, the two can get good and harmonious results even under the difficulties imposed by modern conditions. The common mistake is in calling in the engineer, not to work with the architect from the start, but to rectify his blunders later. A large building is erected under the full supervision of an architect. After it is occupied, it is found that the lighting is in amount or kind totally unsuitable, and the illuminating engineer is called in. He works then on things as they are, without the advantage of co-operation, and if he commits æsthetic sins they are at least sins no worse than those which prompted his opportunity. The lighting and the scheme of decoration should be worked up simultaneously; but proper lighting, from the standpoint of illuminating engineering, should be considered as much a fixed requirement as suitable heating or proper structural strength. Adequate lights are like adequate radiators, necessities, with the advantage that they can more readily be modified in accordance with æsthetic considerations. Good lighting can be made artistic more easily than artistic lighting can be made good; hence the desirability of early co-operation in design between architect and engineer. Both have much to learn, and intimate association will go far toward mutual teaching and appreciation.

Marseilles International Electrical Congress.

An electrical congress will be held at Marseilles, France, from Sept. 14 to 21, in connection with the International Electrical Exhibition of Marseilles. The congress will have as honorary presidents, M. Mascart, Member of the Institute, president of the permanent committee of electricity; M. D'Arsonval, Member of the Institute, professor at the Collège de France; M. Marcel Deprez, Member of the Institute; M. Hippolyte Fontaine, electrical engineer. The active president will be M. Maurice Levy, Member of the Institute, inspector-general of bridges and ways, professor at the Collège de France and the Ecole Centrale, vice-president of the permanent committee of electricity. M. Paul Janet, professor at the Sorbonne and at the Ecole Supérieure d'Electricité, director of the Central Laboratory at Paris, will be first vice-president.

This congress will hold general meetings and section meetings, and visits will be made to industrial establishments. Members of the congress will have the advantage of reduced rates at several hotels in Marseilles, as well as reduced rates when traveling on any of the French railroads.

Manuscripts of papers for presentation before the congress may be sent to the General Secretary of the Exposition, 63 Boulevard Haussmann, Paris, France, before July 15. The admission fee to the Congress will be 20 francs. Checks or money-orders may be made payable to Monsieur le Trésorier du Congres, 63 Boulevard Haussmann, Paris, France.

The congress will be divided into nine sections, as follows: Section I. Governmental regulation and control, in which subjects relating to legislation, prevention of accidents, taxes and franchise will be considered. Section II. Construction and protection of electrical systems, comprising the subjects of insulation, overhead and underground distribution. Section III. Technical and commercial operation. Section IV. Lighting and domestic applications; photometry will be included in this section. Section V. Applications to the industries, including mines, traction and agriculture. Section VI. Electrochemistry and electrometallurgy. Section VII. Telephony and telegraphy. Section VIII. Electrotechnical education. Section IX. Applications to hygiene and medicine.

Over-capitalization and Issue of New Public Utility Securities.

In authorizing an issue of bonds and stocks by the Watertown (N. Y.) Light & Power Company, the New York State Public Service Commission of the Second District has laid down its policy with regard to permitting the issuance of new securities by corporations with existing capitalization, and with regard to expenditures by public service corporations for purposes other than public service. The Watertown municipal authorities had contended the company was over-capitalized and had urged that before granting the application a careful valuation of the corporation's property be made. In the opinion, written by Commissioner Osborne, it is decided that:

"The existing capitalization of a public service corporation need not necessarily be examined into before authorization of securities, under section 69 of the Public Service Commissions law. The material question on such application is whether the desired issue of securities is necessary for one of the purposes specified in that section.

"Public service corporations may be authorized to make expenditures incidentally for purposes other than public service, if such expenditures are on property to be used ultimately and properly for such public service.

"The purchasers of securities authorized by this commission are not exempt from the business risks involved in the possibility of the corporation issuing the securities being over-capitalized."

The commission authorized the issue of bonds and stock by the company, for the discharge of its lawful obligations, to the amount of $200,000 5 per cent gold bonds to be sold at not less than 80 per cent of their par value, and $102,500 stock at par.

It is provided in the order that "any excess in the proceeds of this issue of bonds which may be realized from the sale of them at a price above 80 per cent of the par value thereof shall operate to reduce to the extent of such excess the amount of capital stock authorized to be issued."

The applicant company took over the property of the Remington & Sons Pulp & Paper Company, which owned valuable water-power facilities, and this the commission approves as a proper business undertaking, looking toward the future development of the Watertown Light & Power Company in its public service capacity of furnishing to Watertown and its vicinity light and power.

The commission in its order disallowed the amount set down for improvements made upon the Remington property prior to June 4, 1906, which was $14,134.78.

"These improvements were made before the date of the filing of the original application herein referred to," says the order, "and in our opinion these amounts are properly regarded as included in the capitalization allowed by the former Commission of Gas and Electricity." Also there is disallowed $175 for rent of contractor's office, $784.15 for improvements to buildings not used for the light or power purposes, $7,425 for salaries and $3,725 representing excess rental of contractor's plant. In addition to the above amounts $919.29 was withdrawn by the applicant in the proceedings upon the application, making a total of $27,163.22.

The city of Watertown, as represented by its Mayor and Attorney, had insisted that the company, under the order of the former Commission of Gas and Electricity allowing a capitalization of $700,000, was greatly over-capitalized.

Wire Inspection Bureau.

At a meeting of 26 wire manufacturers, representing practically all the important rubber-covered wire interests in the country, at the Hotel Manhattan, New York City, on Friday, March 20, it was decided that the control of the Wire Inspection Bureau should be placed, as far as the manufacturers were concerned, in the hands of the Rubber-Covered Wire Engineers' Association. This step followed the action of the Underwriters' Laboratories in withdrawing from the Wire Inspection Bureau. The manufacturers decided that they themselves could supervise the inspection and labeling of wire, and that the Rubber-Covered Wire Engineers' Association, to which all manufacturers of approved wire are eligible, was well fitted to have charge of the Wire Inspection Bureau in order to maintain its high standards. The engineers will select the governing board of the bureau, and will represent the manufacturers in all bureau matters. Every manufacturer of rubber-covered wire whose name is on the approved list of the National Board of Fire Underwriters has been invited to join the Engineers' Association, and nearly all have become members, so that it is possible for every manufacturer of approved wire to be represented on the Wire Inspection Bureau as a member of the Engineers' Association.

Following the circular letter issued Feb. 15 by the Underwriters' Laboratories, of Chicago, which has been printed in these columns, and in which a statement was made that the Underwriters' Laboratories could no longer indorse the label service of the Wire Inspection Bureau, the committee appointed by the wire manufacturers attended a conference at which were present the chairman and several members of the executive committee of the National Board of Fire Underwriters, the secretary and other representatives of the Underwriters' National Electric Association, the president and other representatives of the Underwriters' Laboratories, and all the gentlemen heretofore composing the committee on finance and specifications of the Wire Inspection Bureau. The representatives of the insurance companies made it plain that they had no de-

sire to injure in any way the interests of the manufacturers, but, on the contrary, were extremely anxious to work harmoniously with them in a joint effort to establish a high standard of manufactured product and insure that all product sold should be kept up to such a standard. The manufacturers explained that it would not be satisfactory to them to admit into their works inspectors exclusively under the employ of the Underwriters' Laboratories, or any other organization in the management or control of which they had no voice. The underwriters stated that they did not desire to force on the manufacturers a stamp or label device, and that they would go no farther than to offer such service, if it was desired by the manufacturers. After due consideration, the manufacturers decided to take into their own hands the matter of supervising the inspection and labeling of wire and that their united indorsement of any system would answer all purposes.

The Wire Inspection Bureau under the control of the Engineers' Association will continue the work which it has carried on in the past, with only such improvements as may be suggested from time to time by the Underwriters' Laboratories, the manufacturers themselves or any other parties interested. The Wire Inspection Bureau will give label service only to manufacturers who are producing an approved wire. The labels or stamps used will be a certification by the united manufacturers that any wire bearing such stamp is fully up to the Underwriters' Laboratories standards. The Wire Inspection Bureau was formed on May 22, 1905, by the rubber-covered wire manufacturers and the National Board of Fire Underwriters, and was organized to protect reliable manufacturers against unfair competition and to prevent practically the use of wire with defective rubber insulation. A joint committee of six was chosen to decide on wire tests, and three inspectors were appointed to visit the testing laboratories of factories making rubber-covered wire and to supervise and verify tests specified by the bureau. The expenses were paid by fees collected from the manufacturers whose product was tested, each company paying its share in proportion to the amount of wire manufactured.

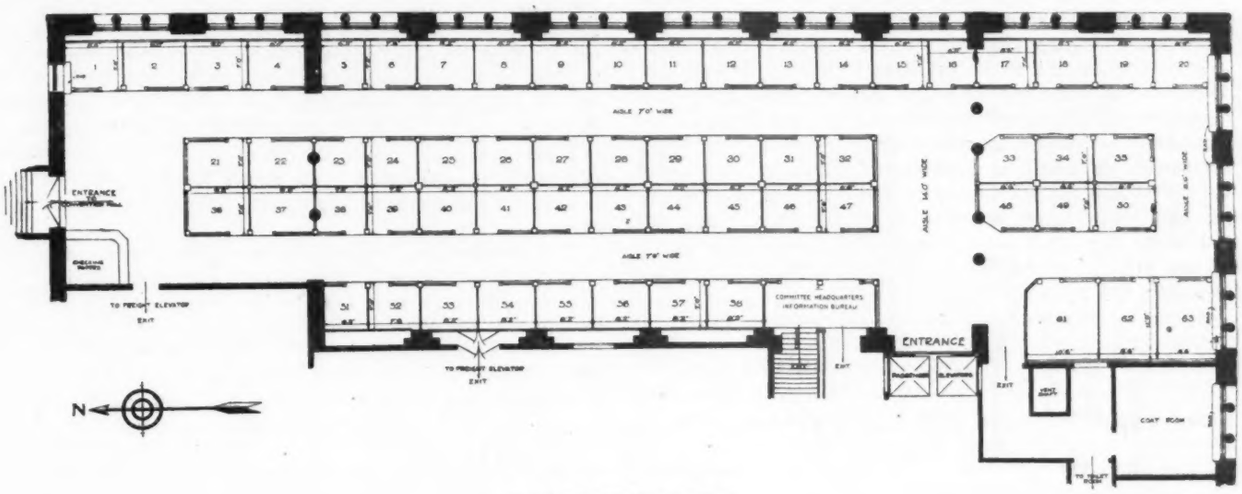
N. E. L. A. Chicago Convention Exhibition.

The accompanying illustration is a plan of the space available for exhibits at the Chicago convention of the National Electric Light Association. As previously announced, the convention will be held in the Auditorium and Annex, May 19-22. The exhibits will be located in the large hall on the top floor of the Auditorium Hotel, which adjoins and connects with the meeting-room. The elevators leading to this floor are so located that members attending the sessions will pass through the exhibition hall to gain entrance to the meeting-room. The well-known architects, Messrs. D. H. Burnham & Company, will have charge of the designing booths and decorative treatment.

There are 63 booths in all, ranging in size from 44 sq. ft. to 124 sq. ft. The prices to exhibitors include the erection of a platform, posts, railings, painting, a sign bearing the name of the exhibiting member, furniture consisting of a table or desk and two chairs, and current and lamps for lighting the booth. Direct current at 110 volts (two-wire system) for operating exhibits and other special purposes will be available at 5 cents per kw-hour.

For the convenience of exhibitors, arrangements have been made with the Joseph Stockton Company, of Chicago, for the handling of exhibits. All packages should be addressed to the exhibitor in care of the Joseph Stockton Company, to whom should be sent the bill of lading direct. The boxes will be stored in this company's freight barns and delivered into the Auditorium on Saturday, May 16, and Monday, May 18. In order to avoid delays it is suggested that all shipments be made so that they will reach Chicago a few days before Saturday, May 16.

The exhibitor must be a commercial member of the association. Exhibitors must have their booths ready Monday evening, May 18, at 7 o'clock. During the convention a "Convention Daily" will be published by the association on each of the four days of the exhibition, under the management of Mr. C. W. Lee. Secretary Neumuller, of the Exhibition Committee, reports that by the second day after the circular was issued giving details of the exhibition, applications for more than a third of the exhibition space were received, and the committee believes that by the end of this week the entire space will be sold.



PLAN OF BOOTH LAY-OUT.

The tungsten lamp will play a prominent part in the illumination of the exhibition hall. The color-scheme is receiving a great deal of attention, and it is the desire to make the exhibition attractive not only from a commercial standpoint, but also from the artistic standpoint.

Electric Club in Chicago.

The Electric Club organized in Chicago several weeks ago in an informal way for the purpose of getting electrical men together at luncheon once a week has now been formally incorporated under the laws of the State, and at the meeting March 18 the election of the following officers was ratified: President, Mr. C. A. S. Howlett, of the Western Electric Company; vice-president, Mr. A. L. Millard, Westinghouse Electric & Manufacturing Company; secretary, Mr. S. M. McFedries, J. L. Schureman & Company; treasurer, Mr. W. P. Crockett. The club meets together at lunch in the German Room of the

Grand Pacific Hotel every Wednesday at 12:30 p. m. At each meeting a few minutes' informal talk is given by some member on some practical electrical subject. The club is composed of manufacturers, salesmen, jobbers, consulting engineers, and in fact men from all branches of the electrical business. It is proposed to have a smoker and entertainment April 3.

International Candle-Power Unit.

At the general meeting last June in Boston of the Illuminating Engineering Society, a sub-committee of the Committee of the Society on Nomenclature and Standards was appointed to study the question of a unit of luminous intensity. Later committees were appointed by the American Institute of Electrical Engineers and American Gas Institute to co-operate in the work, and in February a final joint report was made. This report has been approved by the two last-mentioned bodies, and will shortly come up for action before the Illuminating Engineering Society, with no doubt as to its acceptance by that body.

The report recommends the adoption of a common national unit of candle-power, which will be maintained by the National Bureau of Standards, from which will be issued secondary standards for practical photometric work. The committee recommends that steps be taken to secure an international agreement as to a candle unit; to this end no definite value is assigned to the unit, which is left to be fixed by international agreement with the condition that it shall represent approximately the average of the candle units at present in the national laboratories of the United States, England and France. Pending such agreement it is recommended that a common candle unit be used in this country which shall be 2 per cent less than that now maintained at the Bureau of Standards, since there can be no doubt that such a candle unit would differ by less than 1 per cent from the international standard that would probably be fixed.

Public Utilities Accounting.

At the public hearing on the subject of gas and electric accounting, which will be held by Public Service Commissioner Maltbie, March 26, at 10:30 a. m., there will be present, besides the Commissioners of the First and Second Districts, the accounting committees of the American Gas Institute, the National Electric Light Association and the Empire State Gas and Electric Association. An invitation has been extended to the representatives of the Massachusetts and Wisconsin Public Service Commissions to be present, and representatives of other gas and electric companies, accountants and others interested in the subject of accounting will be welcomed. The subject of the hearing will be the tentative classification recently submitted in pamphlet form by the Commission of the First District. Everyone will be given a chance to be heard, and it is hoped that some basis for a universal system of accounting may be reached. As matters now stand, it is not likely that the present tentative system will be adopted as a whole; in fact, it was stated by one in close touch with affairs that the Wisconsin Commission would positively refuse to accept the classification in its present form. It has been criticised because the item "working capital" has been left out, characterized as "crude" and objected to on the grounds that it is not easily understood except by experts, and represents the ideas of the New York companies without regard to outside interests. "The basic question," said one who has been following the matter closely, "is whether the classification shall show everything or as little as possible. The New York companies seem to be working to make the classification show as little as possible, while the other interests are anxious to make it a full and public record which will not require an expert accountant and a week of time to decipher."

Annual Meeting of the New England Electric Lighting Engineers.

The annual meeting of the New England Association of Electric Lighting Engineers was held at the American House, Boston, on March 18. President W. L. Mulligan was in the chair. During the business meeting Mr. S. Fred Smith, general manager of the Salem Electric Lighting Company, was elected president for the ensuing year, and Mr. Cole, of the Waltham Gas Light Company, was elected secretary.

THE TUNGSTEN LAMP.

Mr. J. S. Whitaker, of the Rockingham County Light & Power Company, Portsmouth, N. H., read a paper on the "Introduction of the Tungsten Lamp." Mr. Whitaker discussed the appeal to the customer of the tungsten lamp, especially in relation to the unprogressive merchant in need of more and better light. Citing a life test made upon an 80-cp, 115-volt lamp, the speaker stated that it burned 864 hours continuously, with no perceptible change in color or diminution of light, though no photometer test was made. He cited a small dry-goods store, which originally had an installation of incandescent lamps and gas arcs combined. Tungsten lamps were installed in the show windows, and one wing on free trial, with the result that an order was placed for a complete tungsten installation. The lighting cost to this merchant last December was 20 per cent less than a year ago. During the last seven months Mr. Whitaker purchased 850 tungsten lamps; of these 27 were broken in transit, 418 were installed and 143 burned out. It was found that 75 per cent of the early burnouts occurred in the first 100 hours. Later lamps are better and more uniform. A charge of $1.75 each for 100-watt lamps is made to the consumer. This allows for transportation and breakage. The company replaces all lamps not burning 100 hours.

Mr. Whitaker has found the "Meridian" fixture neat and economical for tungsten installations. For store lighting, the bowl-frosted lamp with bowl reflector he had found satisfactory, and for window work a clear lamp with a concentrating reflector located high in the window near the front.

In the brief discussion, Mr. Wilcox, of Lowell, stated that a rental basis of 25 cents per month had been found satisfactory in meeting the gas-arc competition. Mr. Sands, of Haverhill, loans the shade and reflector in store installations of tungsten lamps; if one is broken or lost the customer pays for it. Mr. Cowles, of the Boston Edison Company, said that his company has put out about 1200 80-cp tungstens, charging an excess of $1.10, the lamp remaining the property of the company. Breakage does not seem to be a bugbear. The life appears to be very good—so far at least 700 hours. The company places the lamps in the sockets itself, pendent sockets being used. Mr. Hale, of the Boston company, pointed out that most customers appear to prefer the lamp installed with a clear shade, even though the company advises the use of a sand-blasted globe and etched shade.

In Peabody, 100-watt lamps are installed to meet gas-arc competition at a charge of $1.50, with a guarantee that the annual cost of renewals shall not exceed $3. The gas people charge a yearly rental of $3 per lamp. In this town the tungsten lamp replaced a gas-arc installation in a bowling alley. Formerly there was one gas lamp between each pair of alleys; the tungstens were placed one over each alley with reflectors keeping the light out of the eyes of the patrons, and directing it to the pins, the result being a great improvement.

THE BOILER PLANT.

The next paper was by Mr. F. S. Allen, of the Hartford Steam Boiler Inspection & Insurance Company. The subject was the diseases of boilers. Mr. Allen first discussed the failure of the lap seam. In the years when iron plate was exclusively used in the construction of boilers, there were but few failures from this defect. Steel seams resent treatment that iron withstood, and in cases of seam distortion from true circular form, fracture at the longitudinal joints is probable. Proper

bending in the rolls is of great importance. Often the plates are not bent so as to conform to each other, and when the rivets are closed and brought together, a reverse strain is caused in the material, developing incipient fracture from the beginning.

Another defect is improper pressure in closing the rivets. Ruptures of plates due to this cause have been no respectors of factors of safety or age of boilers. Crystallization is another source of trouble. This is found in boiler tubes made of inferior material, as well as in plates. Not infrequently there is some unusual color or sound that will attract the attention of the examiner, in the line of crystallation evidence. A case of this kind occurred in a large battery of boilers in which there was no evidence of thinning or overheating, distortion or of sediment found in the tubes. They gaged to their full standard thickness for their diameter, but there was a peculiar, unusual color when rubbed clean of soot and ash to the original skin of the metal, but not showing under file any change except bright metal. Two tubes were removed for test, and as a result, all the tubes in the boiler had to be replaced. In the same plant were boilers operated 23 years at 125 lb., but these others that were defective were operated at 160 lb. The trouble was assigned to the higher temperature and pressure of the latter.

Of late there have been many defects found in the bolts that hold the tube caps on the manifolds on some types of water-tube boilers. This is a dangerous defect, as most of these boilers are operated under high pressure and the caps are upon the outside, so that the giving of the bolts releases the entire contents of the boiler into the fireroom. This has become of such seriousness as to be taken up with one of the largest electric-road operators, and chemical tests have been made of the bolts. It is thought that the use of commercial steel bolts is responsible for the trouble, and the remedy seems to be the use of the best quality of Norway iron. These bolts are not subjected to expansion strain or vibration, and the trouble is probably due to the constitution of the material, which seems to lend itself to crystallization.

Mr. Allen then discussed the subject of scale. Water-tube boilers are particularly sensitive to this trouble. The failure of tubes is also sometimes due to improper welding. With the temperature due to higher pressure there are some new developments in scale formation, especially in the fire-box type of upright boilers. There is too little space for scale deposit on the tube sheets, and the large amount of heating surface and the normal evaporation with brackish water show rapid scale formation on the tube sheets directly over the fire. Judicious use of solvents is essential in such cases. It has been found that the difference in temperature between steam at 125 lb. and at 160 lb. is probably sufficient to preciptate out of the ordinary sediment a small amount of sulphate of lime. Feed water containing nitrates is very bad for boilers, as a nitrate compound is a deadly enemy to iron and steel plates.

Trouble with lubricating oils continues to be one great cause of boiler failures. Separators are put up without reference to the volume of steam that is to pass through them. Separators have capacity as well as other machinery. Oil can be readily removed from some types of boilers by swabbing the sheets and tubes with a mop dipped in kerosene oil, with no open lights around the boiler. Boilers inaccessible for mopping can be boiled out with a large amount of caustic soda and kerosene oil pumped into the boilers, and a pressure of two-thirds the normal being maintained for 12 to 20 hours, when the sediment can be readily washed out.

Corrosion is still found in some types of boilers. Where the water is pure and the boilers are operated intermittently, corrosion is frequently found in the form of pitting. Banking the fires for a number of days and keeping the water in a nearly torpid condition, sometimes causes pitting. Once started, corrosion provides its own fuel unless checked. With pure water one of the best treatments is to keep the water alkaline with soda ash. It is important frequently to ream and keep free the openings in bolts drilled as a source of protection, for a solid residue often becomes baked in the bolt center.

Many of the minor diseases of boilers, as rapid loss of ductility and development of incipient fractures at different parts, as in the plain tubular boiler, at the girth seams, may be due to imperfect operation, varying water levels, and the introduction of cold water. The burning out of one fire in a battery, leaving the drafts full on, and the boiler connected with the rest of the battery under full pressure, is a severe strain on boilers, often causing leakage at stay bolts and seams and around the tubes of fire-box boilers.

Mr. Allen closed by a brief discussion of the superheated-steam question. The burden of his remarks was that cast-iron is not a suitable material to use in connection with superheated steam in boiler construction. He had seen some of the best makes of extra heavy valves with cast-iron bodies on superheated steam at high temperatures, that in a few months had become badly checked and marked, affecting the whole body of the valve. Soft-steel castings were substituted, with good results so far. Fittings or manifolds of cast-iron connecting superheaters with generators at over 100 deg. superheat should not be endorsed.

Mr. A. J. Campbell, manager of the New London Gas & Electric Company, read a paper entitled "Comments." He discussed his experience with a CO_2 recorder, which showed that when the instrument was properly and intelligently handled it would give accurate results. The stack draft in the plant is controlled by an automatic damper regulator, operated by steam pressure. After a series of tests, it was found that by leaving the furnace doors open and trying to produce poor conditions, the CO_2 average could only be reduced to about 8 per cent, while, on the other hand, the best results obtained averaged 10 and 11 per cent CO_2, indicating a loss up the stack of about 20 per cent. It is very possible that where the boiler conditions are very poor, the use of a CO_2 recorder will effect a great saving. If the CO_2 does not average over 5 per cent, the loss up the stack will be 40 per cent and over, and with a recording instrument for a guide, the CO_2 average should easily be brought up to 9 or 10 per cent, reducing the average loss to about 20 per cent. If the CO_2 average is already around 9 or 10 per cent, it is doubtful how much practical gain comes from the use of such an instrument.

METERS.

Mr. Campbell concluded by emphasizing the importance of keeping up meter records. It is essential to know how many meters have been purchased, where all meters are in use, stock lost, if any, repaired, etc. Mr. Sands, of Haverhill, described his system of keeping track of all meters by issuing orders for sets and removes in quadruplicate, and by making up a monthly meter statement covering the subject completely. Of the quadruplicate orders, a copy goes to the superintendent, cashier, meter department and meter setter. The orders are filed numerically, and by keeping an exact record in this way no meter is lost or allowed inadvertently to be loaned to a customer without the company's knowledge.

Meeting of A. I. E. E. Ithaca Section.

At the "education meeting" held Feb. 21, Dr. Steinmetz's paper on "Electrical Engineering Education" was read, and in the discussion students gave the results of their own experience in class work. Following the formal part of the meeting, an informal smoker was held in the offices of the electrical engineering department, and an opportunity was thus afforded for the local members to become better acquainted, and to take up individual points, which could not be discussed in the meeting.

On March 6 a very profitable discussion followed the presentation of the following papers: "The Non-Synchronous Generator in Central-Station and Other Work," by Mr. W. K. Waters, abstracted by Mr. H. W. Smith; "Some Developments in Synchronous Converters," by Mr. Charles W. Stone, abstracted by Mr. H. L. Sharp; "Some Features of Railway

Converter Design and Operation," by Mr. J. E. Woodbridge, abstracted by Mr. E. J. McIlraith. These papers are being used as reference text in connection with the senior lectures in electrical engineering.

Alternators in Parallel.

A meeting of the Electrical Section of the Western Society of Engineers occurred Wednesday evening, March 11, at which a paper entitled "Alternators in Parallel" was read by Prof. Morgan Brooks, of the University of Illinois. Prof. Brooks opened his paper by stating that motor-generator operation and parallel operation of alternators are theoretically one and the same. When two synchronous machines are running in parallel and one machine falls the smallest fraction of a cycle behind the other in vector position, it necessarily receives power from the other machine in the same sense that a motor receives power from its generator. A normal vector difference for motor operation as compared with generators would be, perhaps, 10 electrical degrees. Alternators in parallel will oscillate through vector positions of perhaps 2 or 3 deg. or more when what is commonly known as hunting occurs.

Prof. Brooks showed a pair of bicycle wheels arranged on a stand to illustrate this hunting action. The wheels were mounted side by side and had weighted rims. An elastic band connected the two wheels in parallel so that they always maintained a nearly equivalent position. This illustrated the fact that two alternators are forced toward equality of phase position no matter which one leads the other, and also that such compulsory action exists actually to hold machines in stop.

Several charts were shown arranged with movable pointers by which readings of e.m.f. and current could be made from the chart. These charts illustrated the essential differences between parallel operation in the same station and in connection with long-distance transmission, and showed why a motor connected through transmission will fall out of step more easily than one connected to its generator in the same station.

The interesting feature of the evening was a demonstration of ordinary synchronization and Prof. Brooks's self-synchronization method. Through the courtesy of the Commonwealth Edison Company a synchronizer and ammeter at the lecture hall in the Monadnock Building were connected to the switchboard gallery at the Harrison Street station so that all the usual switchboard indications of phase difference and current could be read direct by the audience in the lecture room.

A 200-kw rotary converter was motor-driven and thrown in parallel with the station busbar. The first experiment was done as accurately as possible with no noticeable ammeter deflection. In the second experiment the motor-generator was switched in at perhaps 15 deg. out of phase, when a rush of current amounting to 2000 amperes was observed, representing a momentary overload of about 50 per cent. Then a reactance coil was connected between the 200-kw machine and the busbars, and synchronizing was done 30 deg., 90 deg. and 180 deg. out of phase, the maximum current being about 600 amperes at 180 deg. As a final exhibit, the motor was speeded up until a considerable difference in speed was attained, the synchronizer revolving too rapidly for proper switch closing. A paralleling switch was then thrown, and speed adjusted until the machine was running steadily. The coil actually used for this work consisted of 120 lb. of No. 0 copper wire wound on a reel just as it came from the storeroom.

In discussing the paper, several speakers spoke of the reduction of synchronizing difficulties to-day as compared with conditions of 10 years ago before the introduction of the synchronizing instruments. Mr. E. F. Smith, of the Commonwealth Edison Company, stated that damage due to synchronism was a negligible factor in their operation to-day, and that no trouble had arisen for many years. He suggested, however, that this method would doubtless serve for quicker synchronizing of frequency changers. In such a use reactance coils would be connected both in the motor and generator circuits, and both motor and generator switches closed at once. Mr. Abbott, also of the Commonwealth Edison Company, stated that a smaller size of wire could be used for synchronizing than in this case, and he believed that under favorable conditions ½ lb. of copper per kilowatt would be sufficient for such a coil.

Prof. Brooks closed the discussion by calling attention to the rather unexpected reactance of such small coils in this work, such a coil probably being cheaper than a reactance with an iron core. A considerable current overload might safely be carried, since the coil was in use for such a very short time. When the inductance depends on the magnetization of an iron core a large momentary rush of current may occur and the very purpose of the coil be thereby destroyed.

CURRENT NEWS AND NOTES.

MULTIPLE UNIT MOTOR CARS FOR N. Y., N. H. & H. R. R.—The New York, New Haven & Hartford R. R. has ordered from the Westinghouse company four multiple-unit, direct-alternating, single-phase motor cars to supplement its electric locomotive equipment.

AMERICAN ELECTROCHEMICAL SOCIETY.—A meeting of the New York section of the American Electrochemical Society will be held at the Chemists' Club on Friday evening, March 27, at which Dr. Clayton H. Sharp will deliver a lecture on "Electric Illumination with the New Arc and Incandescent Lamps." The annual meeting of the society will be held at Albany, N. Y., on April 30, May 1 and 2. One of the days of the meeting will be spent in Schenectady and another in Troy.

N. Y. ALUMNI ASSOCIATION OF GEORGIA INSTITUTE OF TECHNOLOGY.—A permanent organization has been effected with headquarters in New York City of the New York Alumni Association of the Georgia Institute of Technology. It is composed of those graduates of the above institution who live in or near New York City. During the last 12 years this institution has grown so rapidly in size and importance that the number of buildings occupied and amount of ground covered equal that of much older technical institutes elsewhere. This association will undoubtedly result in much good both to the alumni and to the college. The secretary of the New York Association is Mr. J. H. Williams, of 299 Broadway. The executive committee is composed of Messrs. C. E. Fairbanks, H. F. Jeter, F. C. Furlow, C. J. Merritt, H. L. Snowden, F. C. Morton and F. V. Stephens.

NEW YORK PUBLIC SERVICE LAW.—Messrs. Page and Wainwright have introduced in the New York Legislature a bill amending the Public Service Commissions law and adding thereto a new article relating to the regulation of telegraph and telephone companies. There are a large number of important changes in the bill. In article 4, relating to gas and electric corporations, a new section is inserted entitled "safe and adequate service; just and reasonable charges; unjust discrimination; unreasonable preference." Paragraph three of section 66 is changed, giving the commission power to prescribe by order, "the nature, class, kind, character and efficiency of the electric supply system, of the current supplied and of the lamps furnished," etc. In the portion in reference to gas, the word "distributed" is added so that in all cases the section reads "gas . . . manufactured, *distributed* or sold." In paragraph four, in regard to uniform accounting, the following is added: "Where the commission has prescribed the forms of accounts, records or memoranda to be kept by such persons, corporations and municipalities, it shall be unlawful for them to keep any other accounts, records or memoranda than those prescribed." Section 67, in regard to inspection of gas and electric meters, is changed by making the present law apply to gas meters only and adding paragraph three in regard to inspection of electric meters. A large number of corrections are made in the present bill and the duties of the commission are more clearly defined. The powers of the commission by the amendments proposed are considerably increased.

PUBLIC SERVICE HEARINGS MUST BE PUBLIC.—The Up-State New York Public Service Commission has denied an application made by a railway for a private hearing and has ruled that all hearings must be public.

PROF. ERNEST RUTHERFORD, formerly of McGill University and now professor of physics at Victoria University, Manchester, has been awarded a prize of 9,600 lire by the Turin Academy of Sciences for his researches in radioactivity.

KELVIN LECTURESHIP.—The first Kelvin lecturer in the foundation of the British Institution of Electrical Engineers will be Prof. S. P. Thompson, whose opening subject will be "Lord Kelvin: His Life and Works." The lecture will be delivered April 30 at the Institution of Civil Engineers, London.

MUNICIPAL PLANT FOR SALE OR LEASE.—The municipal electric-lighting plant of Spirit Lake, Iowa, is offered for sale or lease. The plant was presented to the town by the Stevens Steam & Electric Company, and began operation in 1900. The equipment consists of a 20-light arc machine and two 120-kw, 60-cycle alternators.

B. A. A. S.—Prof. J. J. Thomson has been nominated as president of the next meeting of the British Association for the Advancement of Science, which will be held at Winnipeg next year, Aug. 25 to Sept. 1. The Canadian Parliament will make an appropriation of $25,000 toward the expenses of the meeting, and the city of Winnepeg will contribute $5,000.

THE UNIVERSITY OF ILLINOIS ELECTRICAL SHOW.—The students in electrical engineering at the University of Illinois, Urbana, which last year held such a successful electrical show, have planned a similar undertaking for this year, March 26 to 28. The show is considered of value by the authorities because of the practical training it affords in organization, handling of men and producing results.

BONAPARTE SCIENCE FUND.—Prince Roland Bonaparte has donated a fund of $20,000 to the French Academy of Sciences, the annual proceeds of which are to be used to assist scientific investigators in researches. The deed of gift states that the allotments are not to be regarded as awards of merit, but as donations to assist in defraying the expenses of investigators who have already made their mark in original research.

ELECTRIC SHOCK RESTORES SIGHT.—According to a newspaper dispatch from Phillipsburg, N. J., a man named John Miller had the sight restored to one eye, blind for 30 years, by a shock from an electric wire. According to the account, when Miller recovered from the shock he saw a woman wearing a blue dress walking in the street. "By gracious, Schooley!" exclaimed Miller to his employer, "I see her with my bad eye."

STREET LIGHTING IN SCRANTON, PA.—During a recent visit to Scranton, Pa., Mr. Leslie M. Shaw, former Secretary of the Treasury, expressed the opinion that Scranton is the best lighted city in the United States. A local journal in commenting on this statement said that the new management of the American Gas & Electric Company has made it an object for merchants and manufacturers to use more electricity, and is doing a great deal to advertise Scranton.

TELEPHONES AND ORCHESTRA PITCH.—At a concert last week in New York given by the Boston Symphony Company, the telephone was utilized to maintain harmony in pitch and rhythm between the orchestra and trumpeters behind the stage. There was placed near the wall, so that the trumpets could catch through it every strain of the orchestral music, a telephone. Over the transmitter was fitted a large megaphone. By this means the trumpets were enabled to keep perfect pitch and rhythm with the orchestra.

VIOLATION OF THE METRIC SYSTEM.—The French Academy of Sciences has, according to a despatch from Paris, condemned the nickel five-sou piece, introduced five years ago, because it does not conform to the metric system. This coin won popular favor by slow degrees, chiefly because it is the price of a first-class fare on the Metropolitan Underground Railway. The Academy wishes to have it replaced by a four sou piece; that is, one of 20 centimes.

OHIO EXAMINATION OF ELECTRICIANS.—The bill introduced in the Ohio Legislature some time ago to provide for an examination of electricians has been amended in such a way as to substitute a chief electrical examiner, with district deputies, instead of a state commission, as was at first proposed. The salary of the chief is to be $3,000 a year, and that of the deputies $1,200. Annual licenses will cost $5, while the fee for renewals will be $3 for all wiremen, helpers, moving-picture operators, operators of theater switchboards and similar occupations. This bill has been recommended by the house committee on manufactures and commerce.

SWISS CENTRAL STATIONS.—A recent report gives the number of Swiss central stations on Jan. 1, 1907, as 559, an increase of 61 over the previous year. Of these 240 generate all of their current, 50 generate only a part, and 249 buy their current. The cost of installation was $212 per kilowatt for stations under 1000 kilowatts, $157 for stations between 1000 and 2000 kilowatts, and $136 for the largest station, which has a capacity of 15,900 kilowatts. Direct-current is supplied by 61 stations (25 per cent), alternating current by 155 stations (65 per cent), and both direct and alternating current by 24 stations (10 per cent). Ten stations supply current at voltages higher than 10,000, the voltage of four being 25,000. One station supplies direct-current at 25,000 volts.

ELECTRIC CARS AT GERMAN AUTOMOBILE EXPOSITION.—At the Berlin automobile and electric motorboat exposition, Consul-General A. M. Thackara reports, electric cars were on exhibition for almost every purpose, from the luxuriously fitted touring car to the lightest delivery wagon. The new Edison storage battery was exhibited by a German company, and among the varied types of electric vehicles was one of the mixed system, that is, an electrically-driven car with a four-cylinder benzine motor to furnish the power for a dynamo generating the current. There were also several new types of electric sparking attachments. Many of the larger cars had the two ignitions, in which case magneto jump sparks and battery ignition, which can be worked independently, were used. Electric cars were exhibited which were guaranteed to run, at a moderate speed, a distance of 100 kilometers (62 miles) with a single charging of the batteries.

PAY-AS-YOU-ENTER CARS IN NEW YORK.—On Sunday, March 22, 155 new cars, of the pay-as-you-enter type, were put into service on the Madison and Lenox Avenue lines of the New York City Railway Company. Each car is 48 ft. long and has a capacity of 75 passengers—38 seated and 37 standing—no more than 75 being taken on. When a car is full a "Full Car" sign is displayed. The cars are equipped with four motors each, and the total cost of the new equipment is about $1,100,000. In addition to this, $400,000 was expended in changes at curves and in the car house to accommodate these extra long cars. If the experiment meets with approval, other lines will be similarly equipped. General Manager Oren Root states that, so soon as the public has accustomed itself to entering and leaving the new cars, machines for collecting fares will be attached to the rails of the entering passageway. "This will leave the conductor," said Mr. Root, "entirely to the important task of starting and stopping the car, which means the elimination of many accidents. He will also make change."

NEW N. E. L. A. MEMBERS.—At the February monthly meeting of the N. E. L. A., 30 company and 24 individual members were elected.

FARMERS DEMAND LIGHT.—Action has been brought against the Peterson Heat, Light & Water Company, a Des Moines, Iowa, company, doing business in that city and Alden, to force it to furnish electric light to two or three farmers living along the 11,000-volt line between the two places.

PUBLIC POLICY COMMITTEE MEETING OF THE N. E. L. A.—On Tuesday, March 17, the Public Policy Committee of the National Electric Light Association held a meeting in the rooms at the association's headquarters in the Engineering Building, New York City. A report was formulated by the committee which will be submitted at the forthcoming convention in May.

"SOCIETY DAY" AT THE ELECTRICAL SHOW.—At a recent meeting of the directors of the Electrical Show, which will take place next October at the Madison Square Garden, Mr. Arthur Williams, of the New York Edison Company, was unanimously elected president, succeeding Mr. George F. Parker. It is planned to set aside a certain day during the show week, which will be called "Society Day." The admission charge on that day will be $1, and the receipts will be donated to some worthy charity.

SURGES AND OSCILLATIONS.—At a meeting of the New York Electrical Society, to be held in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, on Friday evening, March 27, Mr. Ernst J. Berg will present a paper entitled "Oscillations and Surges Affecting the Design of Systems for the Transmission of Electrical Energy." Among the points discussed will be the instantaneous abnormal voltages and currents due to energy stored electromagnetically and electrostatically; surges caused by grounds in transmission systems; surges due to arcing grounds; statics caused by grounds; abnormal voltages caused by triple frequency e.m.f. in transformers; corona effects.

A. S. M. E. APRIL MEETING.—The next monthly meeting of the American Society of Mechanical Engineers will be held in the auditorium of the Engineering Societies Building, New York, on the evening of April 14. The subject to be presented will be "The Conservation of Our Natural Resources," and the meeting will be addressed by four speakers who will consider forest preservation in its relation to water power, economy in the utilization of fuels, and the attitude of the engineer in regard to these. Dr. Henry S. Pritchett, president of the Carnegie Foundation, for the advancement of teaching, will be one of the speakers and will discuss the "Relation of the Engineer to the Body Politic."

TUNGSTEN LAMP IN TOPEKA.—In a current issue of the *N. E. L. A. Bulletin,* Mr. John T. Huntington states that the Topeka Edison company has taken up the large candle-power tungsten units to compete with the mantle gas lamp, and to replace enclosed arc lamps where their use produces bills beyond the means of the customer. He considers that the ideal method under which to furnish high candle-power tungsten lamps for the illumination of stores or large rooms is on a lamp-hour basis in connection with a timing device, which need be nothing more than a common clock mechanism arranged to start and stop by a magnet which is energized from the lamp circuit; this would be much cheaper and far simpler than any of the present forms of meters, and suitable for circuits in stores where all lamps are operated at the same time, and also adapted for use in residences as well, in which case a separate mechanism would be required in each lamp. His company is about to try the experiment of furnishing 100-watt tungsten lamps at a rental charge of 2 cents per day.

EFFECT OF NEW BRITISH PATENT LAW.—According to a consular report, German manufacturers are taking steps to establish plants in Great Britain in order to meet the commercial situation which the new British patent law has created. A large concern near Frankfort-on-the-Main, one of the greatest manufacturers of coal-tar colors and other chemicals (all of which are protected by patent rights) has already taken steps to procure a large tract of land near Ellesmere Point, England, on which it will forthwith have a branch factory built for the manufacture of the principal articles which it sells in Great Britain under protection of patents secured in that country. It is also reported that the great chemical color works at Elberfeld purpose to buy a tract of land in England and erect branch factories upon it so as to be able to hold in future the valuable trade in Great Britain.

ELECTRICAL DEVELOPMENTS IN ITALY.—Consul James E. Dunning, of Milan, Italy, reports that the Municipal Council of Milan has accepted the report of a commission in favor of the construction of a hydro-electric installation in the Alpine hills north of the city, which provides for a generating station of sufficient power to meet the probable demands for current, and has authorized the requisite outlay for the work, $2,546,640, to be raised by a loan guaranteed by the Council. A syndicate has been formed in Rome to provide a hydro-electric generating station at Treni, in Apulia, to produce current to work three railways, viz., from Treni to Corato, from Treni to Andria, from Fernandino to Trinitanople. The station will also supply current to surrounding towns. Steps have been taken for the building in North Italy of the Lake Garda line, to run from Riva di Trento, along Lake Garda, to Verona, 48¼ miles, electricity to be the motive power.

FIRST ELECTRIC ROAD FOR COLOMBIA.—On the steamer *Prince Eitel Frederich,* which sailed last Saturday from New York, was shipped the equipment of the first electric street-car road to be built in the republic of Colombia, S. A. The road will be constructed in Bogota, the capital, and will replace the mule-car lines now in use. The steamer will discharge at the port of Cartagena, and from there the railroad will transport the equipment for 15 miles, when the journey will be continued by water for 400 miles. A trip of 100 miles on mule-back, followed by a water trip and another mule-back journey, will finally bring the equipment to its destination. The cars used will be run by two 25-hp motors each and current will be generated in a power house belonging to the city. The road is not more than six miles in length and eight or nine cars will be used, but eventually the system will be much enlarged. The electrical part of the equipment was furnished by the Westinghouse Company.

LECTURES ON RAILROAD ELECTRIFICATION AT UNIVERSITY OF MICHIGAN.—Prof. C. L. de Muralt, professor of electrical engineering at the University of Michigan, is giving a course of lectures to the senior electrical engineering students at Ann Arbor on the "Electrification of Steam Railroads." Professor Muralt, who has been lecturing during the last semester on the underlying phases of this subject, such as the power-station equipment, transmission and working conductors, motor characteristics, etc., intends to supplement these by a discussion of the technical and commercial features of the following subjects: (1) The general electrification problem. (2) The reasons for electrification. (3) The operating characteristics of steam and electric locomotives. (4) The choice of electric systems. (5) An analysis of the cost of operation. (6) The field of railroad electrification: the congested terminal, the mountain grade and the trunk line. (7) Preparation of an electrification project for a particular road, special attention being directed to such problems as the design of locomotives, the calculation of run sheets, the choice of speeds, study of the peak load, the location of substations, the economics of transmission and other collateral topics.

Electrical Developments in Porto Rico.

SINCE the termination of Spanish rule on the island of Porto Rico, 10 years ago, the value of the exports has tripled, the area planted with tobacco has been more than quadrupled and everything has materially prospered under American administration. Among the important developments of recent date is the construction of an interurban railway for freight and passenger traffic between Caguas and San Juan and a water-power plant to generate electricity for operating the road and for supplying lamps and motors with energy in San Juan and vicinity. Caguas has not heretofore had railway connection with the seaboard, and all transportation of tobacco and other produce has been by means of native ox carts. The San Juan-Caguas railway is the first to penetrate the interior of the island and will be a part of the modern electric street railway system now serving San Juan and its suburbs.

The electrical development mentioned began with the organization, in 1906, of the Porto Rico Railways Company, Ltd., a corporation of Canadian interests with which Messrs. J. G. White & Co., of New York, are associated as engineers and constructors. In the Porto Rico Railways Company, Ltd.,

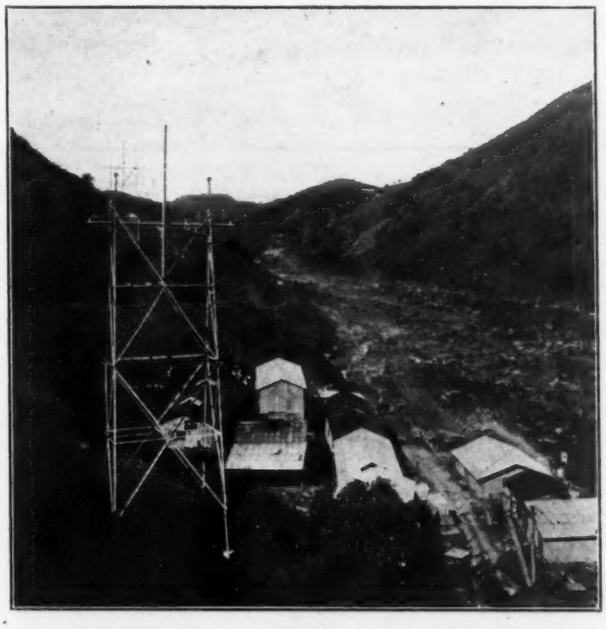


FIG. 1.—TRANSMISSION LINE, COMERIO FALLS AND SAN JUAN.

were merged the San Juan Light & Transit Company and the Porto Rico Power & Light Company. At the same time two subsidiary companies were formed; namely, the Comerio Water Power Company and the Caguas Tramway Company, the former to carry through the water-power project and the latter to build the railway. All of the electricity used in San Juan and vicinity for railway, light and power purposes was generated by the San Juan Light & Transit Company and by the Porto Rico Power & Light Company. Each of these companies operated a steam-driven power station, and the Porto Rico Railways Company, Ltd., will continue to operate one of these plants in conjunction with the hydro-electric station at Comerio Falls. The minimum flow of La Plata River is sufficient to permit the station to generate 1000 kilowatts and the average load that can be carried throughout the year is 1600 kilowatts.

The power plant of the San Juan Light & Transit Company is located on a lagoon at San Turce on the road to Rio Piedras. The equipment comprises 1100 horse-power of Cahall and Babcock & Wilcox boilers; two simple automatic engines connected to two 225-kw, 2200-volt, two-phase, 60-cycle Westinghouse alternators, and another engine connected to a 250-kw, 550-volt, Bullock railway generator. There was until recently also a 200-kw railway unit; but this has been replaced by a 500-kw, 2200-volt, two-phase, Westinghouse steam-turbine unit. The condensing apparatus consists of a Wheeler surface condenser for the older engines and a Worthington barometric condenser for the turbine. Bituminous West Virginia coal costing about $5.50 per ton is unloaded from boats at San Juan and hauled in the company's own cars to the power plant at San Turce. Sea water is used for condensing purposes; the simple engines operating on a vacuum of about 10 in. to 12 in.

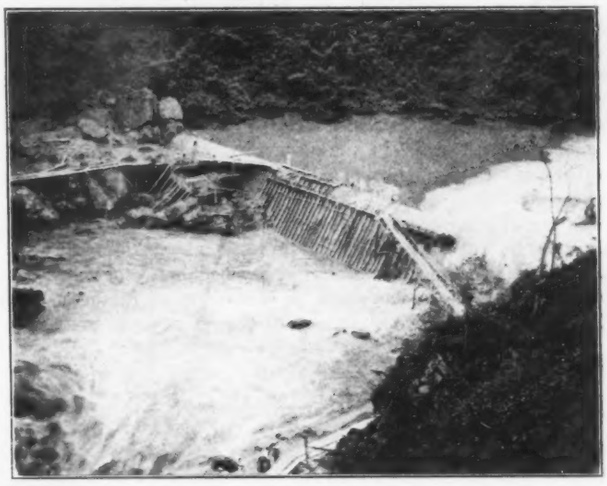


FIG. 2.—COMERIO DAM, TWO SLUICES RUNNING FULL.

and the turbine operating with a vacuum of 27 in. In a substation adjoining the power house are installed two 300-kw, synchronous-motor generator sets and eight 200-kw, water-cooled transformers for stepping down the voltage from 20,000 volts, three-phase to 2300 volts, two-phase. The high-tension current is brought from the hydro-electric station at Comerio Falls. The motor-generators supply the energy for the railway lines. The power plant furnishes part of the energy used for lighting and power in San Juan and vicinity, the remainder being generated in the plant of the Porto Rico Power & Light Company.

The power plant of the Porto Rico Power & Light Company supplies the 2200-volt, single-phase current in San Juan and

FIG. 3.—PENSTOCK AND POWER HOUSE AT COMERIO FALLS.

also energy for a three-wire, direct-current system. This company has the contract for the street lighting of San Juan, the lighting equipment consisting of direct-current, multiple arc lamps. The power-plant equipment comprises 470 horse-power of tubular and water-tube boilers, two tandem-compound and one simple automatic engine from which are belt-driven a total

of 400 kilowatts of direct-current apparatus and one 75-kw, single-phase alternator. The station is near the water front in the central part of the city and supplies most of the energy for commercial circuits and the greater part of the lighting in the central part of San Juan.

The hydro-electric plant of the Comerio Power Company, which will supply the bulk of the energy for railway and lighting purposes in the remodeled system, is situated at Comerio Falls on La Plata River, one of the largest streams on the island. The station is about 20 miles from San Juan and 12 miles from Caguas. The rating of the water-wheels installed is 3000 horse-power and the available head of water is 180 ft. A dam located at the head of the falls deflects the water through a long tunnel and two penstocks to the power house proper located in the gorge below. The dam, which is of concrete, is approximately 40 ft. high and 300 ft. long. The entrance to the tunnel is through steel head gates set in concrete at the west end of the dam. The tunnel is horse-shoe shaped, concrete lined, has a sectional area of 30 sq. ft. and is 2600 ft. long. A reservoir, formed by a concrete dam 28 ft. high, receives the water as it emerges from the tunnel. The penstocks pass from the base of the reservoir to the power

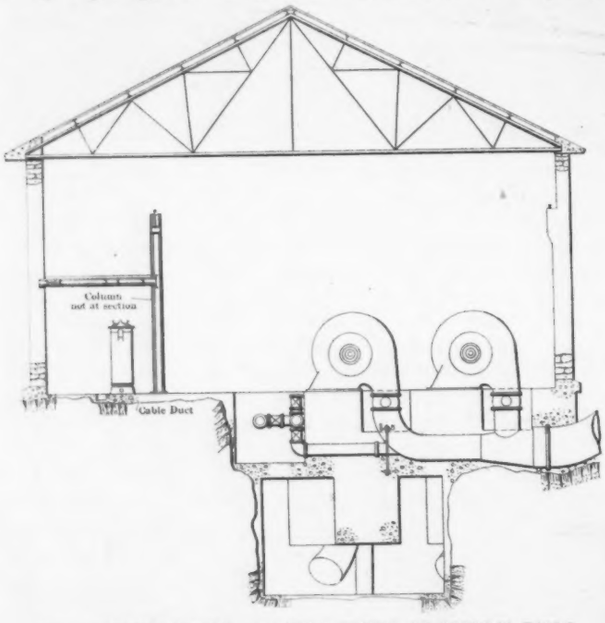


FIG. 4.—CROSS-SECTION OF POWER HOUSE AT COMERIO FALLS.

house, the slope being one in two. The penstocks are 54 in. in diameter and 500 ft. long. They are constructed of tank steel varying in thickness from ¼ in. to ⅜ in. supported and anchored in concrete piers. The main gates at the upper ends of the penstocks are 60 in. in diameter and are provided with bronze facings and seatings with ball-bearing stands.

The power house is constructed of cement-coated rubble masonry, and its sub-structure is built into solid rock. The hydraulic equipment consists of four horizontal wheels of the Francis inflow type built by the I. P. Morris Company, of Philadelphia. Each wheel is rated at 750 horse-power and has a speed of 450 r.p.m. under a 175-ft. head. Two turbines are arranged on each penstock and they discharge vertically into the tail pit through conical draft tubes. The turbines are equipped with Lombard governors.

The main electrical equipment consists of four 400-kw units direct-connected to the water-wheels. The size of the units was selected with reference to the varying demand for energy for operating the railway and commercial load during the day and the full lighting and railway load at night. Three-phase, 60-cycle current is generated at a potential of 2300 volts, the potential being stepped up to 20,000 volts by six 300-kw, oil-insulated, water-cooled transformers. There are also two 40-kw exciter generators driven by Pelton water-wheels rated at 64 horse-power and running at a speed of 450 r.p.m. The plant was erected under difficulties. The nearest government road being 4 miles from the station, machinery, etc., had to be hauled by carts over the steep grades and through streams.

The transmission line to the substation at San Turce is one of the most interesting features of the system. Duplicate lines of No. 4 copper wire are carried on structural steel transmission towers at a height of 40 ft. The wires are spaced 60 in. apart and a wire is carried above the transmission

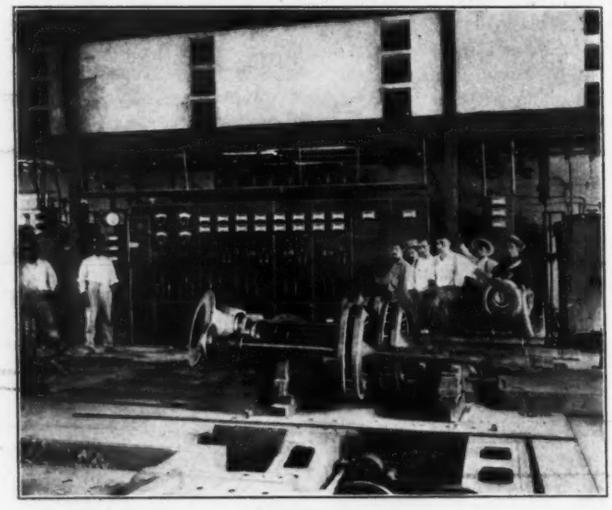


FIG. 5.—INTERIOR OF POWER HOUSE.

circuits as shown and grounded at every fourth tower as a protection against lightning. A private telephone circuit is also installed on the towers. The latter are very heavily galvanized and are spaced 12 to the mile. The transmission line follows the river part of the way, branching thence in a direct line across country to San Juan.

The distribution system in San Juan is unlike that found in the average American city owing to the peculiar lay-out of the city. Like those in many Spanish cities, the streets are extremely narrow so that the lines are of necessity run over the

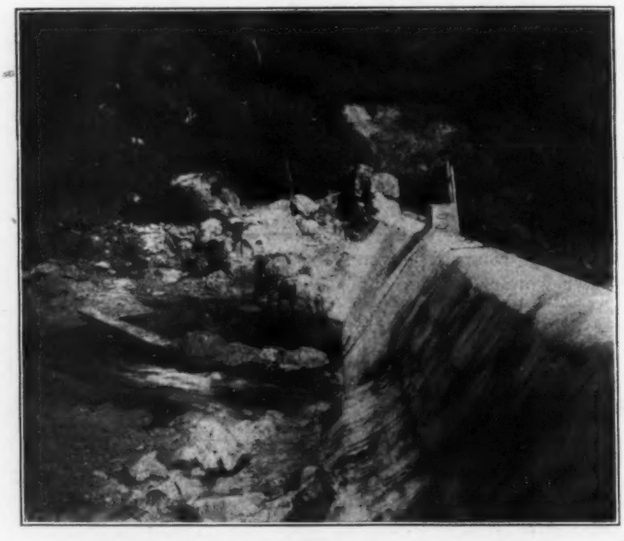


FIG. 6.—LOWER FACE OF DAM, LOOKING EAST.

house tops. A 60-cycle, 2200-volt, single-phase line is carried on the poles of the street railway from San Turce to the city and in the city proper runs over the house tops on bracket construction. Consumers have been grouped on secondaries so that the transformers connected to the lines are fairly large and the core losses therefore moderate. A circuit is also run from San Turce to Rio Piedras.

The direct-current lines of the Porto Rico Power & Light Company are always alive, and there is a single-phase circuit

running from the power plant along the Carraterra to and through San Turce. The street lamps outside the city are connected to this circuit. Both stations supply energy at a flat rate and by meter. The flat-rate customers are connected to either the street lighting circuits or to separate circuits, so that the hours during which lamps may be used is limited.

A New Graphic Method for Determining the Mean Spherical Intensity of a Lamp by the Length of a Straight Line When the Curve of Mean Meridional Intensity Is Given.

BY A. E. KENNELLY.

THERE is a well-known graphic method, generally known as the method of "Rousseau diagram,"[1] for determining the mean spherical intensity of a luminous source, when the curve of mean luminous intensity in altitude, or, briefly, the polar curve, has been obtained. The Rousseau diagram has been much used by photometrists, and has been frequently referred to in photometrical literature, so that no detailed description of it is needed here.[2] Briefly, a circle is described on the diagram about the luminous source as center, and horizontal lines are drawn at successive angular distances, from the zenith to the nadir. Along each horizontal line the mean azimuthal intensity for the corresponding angular distance is laid off, by measurement of the given curve, all horizontal distances being taken from a common vertical. The outlying ends of the various horizontals are then joined by a broken line, and the area contained between the broken line and the vertical is measured. The horizontal length of that rectangle which on the same vertical base contains an area equal to the measured area, is the mean spherical intensity of the source to the scale of the original polar curve.

Examples of the use of the Rousseau diagram are analyzed in this article. The equation of mean spherical intensity is

$$I_m = \tfrac{1}{2} \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} I_\theta \cos\Theta . d\Theta \qquad \text{hefners or candles (1)}$$

where I_m is the mean spherical intensity, and I_θ is the mean azimuthal intensity at the angle of elevation Θ. The Rousseau diagram employs a scale of vertical ordinates corresponding to $d(\sin\Theta)$, and abscissas of I_θ corresponding thereto. The area enclosed under the curve expresses the quantity under the integral sign in (1), assuming that a sufficiently large number of abscissas I_θ have been marked off. The diagram requires to have a surface measured, either by planimeter or by counting little squares on suitably squared paper. The mean spherical intensity on the diagram is essentially a surface or two-dimensional quantity.

Brief Description of the New Method.

The new method described in this article has the advantage of yielding the mean spherical intensity as the length of a certain vertical straight line, or as a one-dimensional quantity. This dispenses with the use of a planimeter or equivalent surface measuring device. It consists essentially in determining graphically from the given polar curve an evolute, and the involute of the same, and then projecting this involute upon a vertical line. Half the length of the projection is equal to the mean spherical intensity, to the same scale as the original polar curve. The entire process requires only an angle protractor and a pair of compasses.

1. "Comptes Rendus des Essais Photométriques à l'Exposition d'Anvers, en 1885," par M. Rousseau.

2. "A Treatise on Industrial Photometry," by A. Palaz, 1894, page 20. "Handbuch der Elektrischen Beleuchtung," by Herzog and Feldmann, 1898, page 10.

Graphical Process of New Method Exemplified with Reference to Simple Circular Polar Curve.

The new graphical method may best be explained by reference to Fig. 1, which shows its application to the particular case of a simple circular polar curve OAHB. This polar curve roughly corresponds to the distribution of intensity from an inverted incandescent lamp, having its base at V and tip at V', except that the tip candle-power does not usually fall off so much as the curve between B and O. The mean horizontal intensity would be OH, the diameter of the circle, and corresponding, say, to 10 candle-power. In Fig. 1 the construction is adapted to zones of 30°. Find the radii of the midzones; i. e., at $+75°, +45°, +15°, -15°, -45°, -75°$. Mark these by the dotted lines Ot, Os, Or, Or', Os', Ot', respectively.

With radius Or and center O, describe the arc hra, through an angle of 30°. Draw the radius Oa at the end of the arc. Measure from a, along aO, a distance ab, equal to Os the

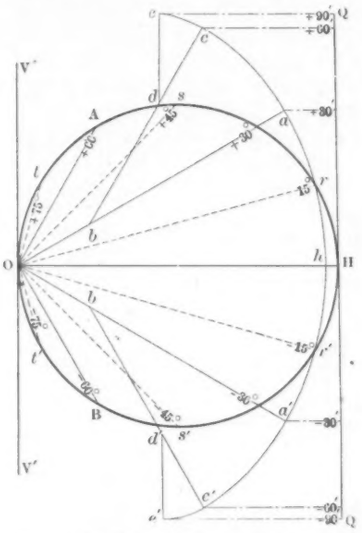


FIG. 1.—NEW DIAGRAM OF CIRCULAR MEAN INTENSITY DISTRIBUTION ON A VERTICAL MERIDIAN THROUGH A LUMINOUS SOURCE. MEAN HORIZONTAL INTENSITY O H = 10.

Rectification by 30° zones. Apparent mean spherical intensity = QQ'/2 = 7.78. Theoretically correct value 7.854.

second midzone radius. With center b, and radius Os, describe the arc ac through an angle of 30°, so that bc makes an angle of 60° with the horizontal OH. Draw the line bc at the end of this arc. From c toward b mark off a distance cd equal to Ot the third midzone radius. With center d and radius Ot describe the arc ce through an angle of 30°, so that de makes an angle of 90° with the horizontal OH. Draw the line de.

Extend the arc h a'c'e' from the horizontal to the vertical beneath in the same manner as above, by steps of 30°, with

TABLE I.

ANALYSIS OF CONSTRUCTION FOLLOWED IN FIG. 1 FOR A LAMP OF SIMPLE CIRCULAR POLAR CURVE.

Elevation θ	Sin θ	Difference $\triangle \sin\theta$	Elevation of Midzone β	cos β	Projected Length cos β ($\triangle$ sin θ)
90°	1.00	.....	.....	.....	.....
60°	0.866	0.134	75°	0.2588	0.034,68
30°	0.50	0.366	45°	0.7071	0.258,82
0°	0.00	0.500	15°	0.9659	0.482,95
					0.776,45

centers O, b', and d' and radii, Or', Os' and Ot' respectively. The curve e c a r r' a' c' e' will now be continuous and complete. Draw a vertical line QQ' through the convenient point H, and project horizontally the points e, c, a, a', c' and e' upon the same. Then half the distance QQ' between the end projections will be equal to the mean spherical intensity of the lamp. The length HQ is the upper hemispherical intensity. The length HQ' is the lower hemispherical intensity. Their arithmetical

mean is the mean spherical intensity. Since in this case the upper and lower hemispheres are symmetrical, $HQ = HQ' = \frac{QQ'}{2}$ = mean spherical intensity. By measurement, this half length is found to be 7.78 units. The lamp would thus have an apparent mean spherical intensity of 7.78 candles, and a spherical reduction factor of 0.778. An analysis of the geometrical construction appears in Table I.

If, therefore, the geometrical construction were perfect, and could be read off with sufficient precision, the mean spherical intensity, with 30° zones, would be 7.7645 candles.

The theoretical value of the mean spherical intensity of any simple circular polar curve whose diameter makes an angle ϕ with the horizontal is by formula (1).

$$I_m = \tfrac{1}{4}\,[\cos\phi\,(\pi - \phi) + \sin\phi] \qquad \text{hefners (2)}$$

a formula which is useful for investigations of this character.

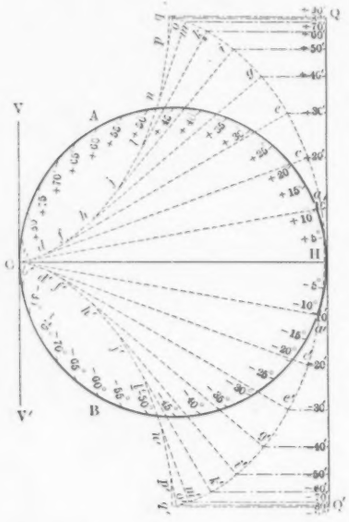


FIG. 2.—NEW DIAGRAM OF CIRCULAR MEAN INTENSITY DISTRIBUTION ON A VERTICAL MERIDIAN THROUGH A LUMINOUS SOURCE.

Mean horizontal intensity OH = 10. Rectification by 10° zones. Apparent mean spherical intensity QQ′/2 = 7.88. Theoretically correct value 7.854.

I represents the maximum intensity or diametral intensity in the polar curve. In the case represented by Fig. 1, the diameter OH of the circle coincide with the horizontal, $\phi = 0$, and $I_m = I\left(\frac{\pi}{4}\right) = 0.7854\,I$. Consequently, the correct mean spherical intensity for the simple circular polar curve of Fig. 1 being 7.854 candles, we should obtain 7.7645 with perfect geometry, when rectifying by zones of 30°, or within 1.4 per cent of the correct value, the diagram actually scaling 7.78 owing to geometrical inaccuracy.

In Fig. 2, the new diagram is constructed for zones of 10° instead of 30°. We therefore arrive at a more nearly correct result by the same process, but with 9 steps in each hemisphere instead of 3 steps. As before, with center O and radius O + 5°, we lay off an arc of + 10°, and join Oa. Along aO, from a, we mark off the distance ab, equal to the second midzone radius O + 15°, and carry the arc to c, such that bc is inclined 20° with OH. Proceeding in this way we draw the continuous curve H a c e g i k m o q, by successive steps of 10°. This curve may be called the *involute*. We also obtain the broken line O b d f h j l n p, which may be called the *evolute*. In fact the successive tangents bd, df, fh, etc., on the evolute, lie upon successive normals ba, dc, fe, etc., to the involute. If pins be inserted at the points b, d, f, etc., on the evolute, a string fastened at the point O and extended without slack to q, so as to carry a pencil at q, would, when unwound toward H, describe and draw the involute q o m.....aH.

A similar construction and condition apply to the involute and evolute of the lower hemisphere. When both involutes are completed, their horizontal projection on the vertical through H gives the distance $QQ' = 2 \times 7.88$ by scaling. An analysis of the geometrical construction, assumed perfect, conducted along the lines indicated in Table I, leads to the value 7.8443 as the result to be expected, a deviation of 0.0097 or 0.12% from the value 7.854 which is correct to four digits, such as would be obtained with perfect geometry for an indefinitely great number of correspondingly small steps and zones.

It is evident, therefore, that for many purposes the mean spherical intensity of such a polar curve could be satisfactorily secured by rectification in 30° zones, and that a high degree of accuracy can, for practical purposes, be secured by rectification in 10° zones. For most purposes 20° zones are recommended as giving practically satisfactory results.

But this is not all. The line of projection QQ′ not only gives the mean spherical intensity on bisection, but it also indicates at a glance the flux of light per azimuthal radian in any zone. Thus, referring to Fig. 1, the line H + 30′ scales 4.8 in terms of OH = 10. Consequently, we know that this lamp emits a luminous flux of 4.8 candle-lumens in the zone 0° to 30° per radian of azimuth, or per equatorial radian. Since there must be 2π radians in a complete circle of latitude, the total flux of light emitted in this 0° + 30° zone will be $2\pi \times 4.8 = 30.2$ candle-lumens. Again the line of projection scales 2.59 between 30′ and 60′ and 0.35 between 60′ and 90′. This means that there must be $2\pi \times 2.59$ candle-lumens of light flux emitted in the entire zone between + 30° and + 60°, and likewise $2\pi \times 0.35$ candle-lumens between + 60° and the zenith. By the same reasoning, the total flux emitted by the lamp will be $2\pi \times QQ' = 2\pi \times 15.76 = 99.0$ candle-lumens. In other words, in order to find how much light is emitted by the lamp between any two zonal angles, multiply by 2π the distance between the projections of those angles on the line QQ′. If the scale of the polar curve be in hefners, candles, carcels, etc., the product will be the required flux in hefner-lumens, candle-lumens, carcel-lumens, etc.-lumens.

Comparison of Rousseau Diagram for Simple Circular Polar Curve.

Fig. 3 gives the Rousseau diagrams for the cases above considered; namely, a simple circular polar curve with its diameter in the horizontal plane. On the left-hand side, the diagram is made for 30° zones, and on the right-hand side for 10° zones. The geometrical analysis for a circle of radius unity and 30° zones is given in Table II. The area of the rectangle USTW is made equal to the area within the boundary S a b c d T l n r m k.

With perfect geometrical construction, therefore, we should expect the Rousseau diagram of 30° zones on the left-hand side

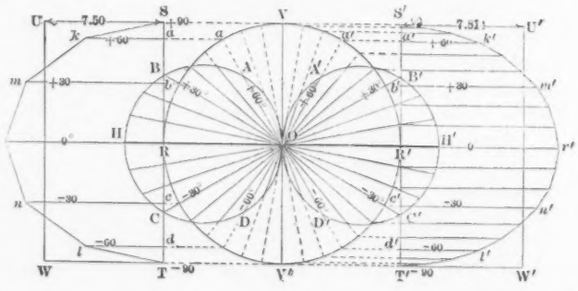


FIG. 3.—ROUSSEAU DIAGRAMS OF CIRCULAR MEAN INTENSITY DISTRIBUTION ON A VERTICAL MERIDIAN THROUGH A LUMINOUS SOURCE.

Mean horizontal intensity OH = 10. For 30° zones, apparent mean spherical intensity US = 7.50. For 10° zones, apparent mean spherical intensity S′U′ = 7.814. Theoretically correct value 7.854.

of Fig. 3 to yield a mean spherical intensity of 7.4998 against a theoretical value of 7.854, a discrepancy of 0.354 or 4.5 per cent.

Turning to the right-hand side of Fig. 3, the Rousseau diagram of 10° zones, when computed in the manner indicated in Table II, gives a result of 0.7814 as the reduction factor, or a mean spherical intensity of 7.814, a defect of 0.040 from 7.854, or 0.51 per cent.

Application of New Diagram to the Polar Curve of a Circle with Diameter Depressed 60°.

If we next consider a case of dissymmetrical distribution of intensity in the upper and lower hemispheres, we may rectify the polar curve OABCD in Fig. 4, which is a segment of a circle, whose diameter OC is taken as 10 units in length, and is depressed 60° below the horizontal plane OH. This type of polar curve corresponds fairly well to that of the ordinary arc-lamp. By substituting $I = 10$, and $\phi = 60°$, in formula (2), we obtain $I_m = 4.783$ as the theoretical mean spherical intensity for this curve. The new diagram constructed in 4 steps, or 30° zones, is given in Fig. 4. It shows that the apparent upper hemispherical intensity is 0.7 units, the lower hemispherical intensity 8.33 units and the apparent mean spherical intensity is 4.515 units. The geometrical analysis appears in Table III.

TABLE II.

ANALYSIS OF CONSTRUCTION FOLLOWED IN FIG. 3, FOR A LAMP OF SIMPLE CIRCULAR POLAR CURVE AND 30° ZONES. ROUSSEAU DIAGRAM

Elevation θ	$\sin\theta$	$\triangle \sin\theta$	Radius Abscissa $\cos\theta$	Mean Abscissa	Area
90°	1.000	.....	0.	.....	.....
60°	0.866	0.134	0.5	0.250	0.033,5
30°	0.500	0.366	0.866	0.683	0.249,98
0°	0.000	0.500	1.000	0.933	0.466,50
					0.749,98

TABLE III.

ANALYSIS OF CONSTRUCTION FOLLOWED IN FIG. 4. NEW DIAGRAM.

Midzone Angle θ'	Midzone Radius $\cos\theta'$	θ	Projection factor $\sin\theta$	Projection $\triangle \sin\theta$	$\cos\theta'$ $(\triangle \sin\theta)$
.....	.....	15°	0.2588	.....	.....
75°	0.2588	0°	0.	0.2588	0.067,24
45°	0.7071	−30°	−0.5000	0.5000	0.353,55
15°	0.9659	−60°	−0.8660	0.3660	0.353,55
−15°	0.9659	−90°	−1.0000	0.1340	0.129,43
					2)0.903,77
					0.451.885

It appears from the above table that with perfect geometrical construction and scaling, the mean spherical intensity should appear in Fig. 4 as 4.51885 units; while the line QQ′ bisected actually indicates 4.515 units. The correct geometrical result of 4.519 units for 30° zones differs from the theoretical value (4.783) by 0.264 unit, or 5.5 per cent.

Repeating the new diagram in this case for 10° zones, as in Fig. 5, we obtain the two involutes ab, and acdq; also the evolutes Oe, and ff′q. The projected line QQ′ has a half length of 4.79 units on the diagram. If we analyze the geometrical construction along the lines indicated in Table III, we obtain 4.7882 as the indicated result, which is in excess of the theoretical value by 0.0052 unit, or 0.11 per cent.

Comparison of Rousseau Diagram for Circular Polar Curve Diametrically Depressed 60°.

The corresponding Rousseau diagrams for the same polar curve are given in Fig. 6. On the left-hand the construction is for 30° zones and on the right-hand for 10° zones. The analysis for 30° zones appears in Table IV.

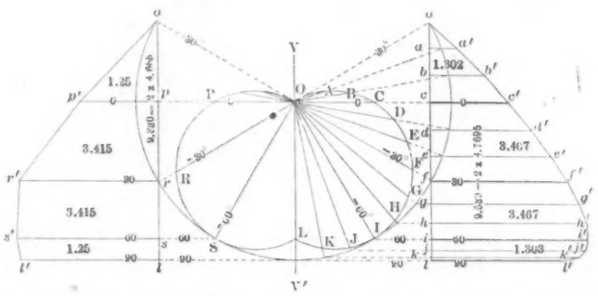


FIG. 6.—ROUSSEAU DIAGRAM OF CIRCULAR INTENSITY DISTRIBUTION, DIAMETER DEPRESSED 60° FOR 30° ZONES AND FOR 10° ZONES.

Mean spherical intensity with no error in graphical work 4.665 and 4.7696. Theoretically correct value 4.783.

TABLE IV.

ANALYSIS OF CONSTRUCTION IN FIG. 6. FOR CIRCULAR POLAR CURVE WITH DIAMETER DEPRESSED 60° ROUSSEAU DIAGRAM. 30° ZONES.

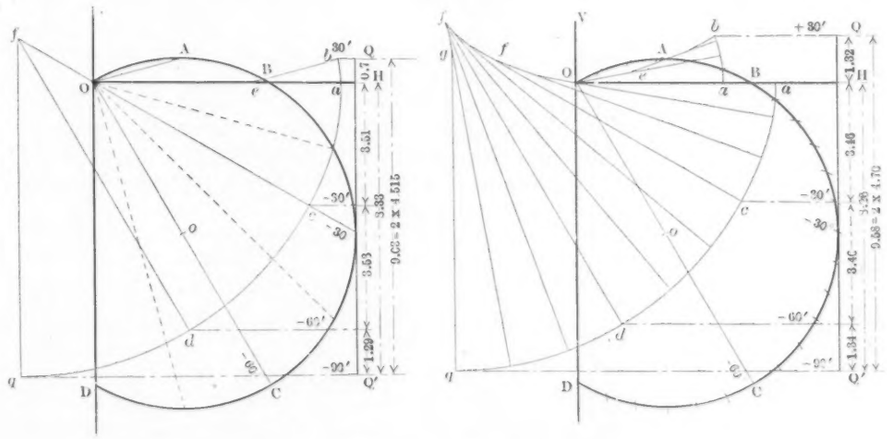
Elevation θ	$\sin\theta$	$\triangle \sin\theta$	Diametral Angle β	Abscissa $\cos\beta$	Mean Abscissa	Area
30°	0.5	0.5	60°	0.5	0.25	0.125
−30°	−0.5	0.5	30°	0.686	0.683	0.3415
−60°	−0.866	0.366	0°	1.00	0.933	0.3415
−90°	−1.00	0.134	30°	0.866	0.933	0.125
						2)0.933
						0.4665

It appears from the above table that if the integration process were conducted faultlessly, the resulting apparent mean spherical intensity would be 4.665 units, as against a theoretical value of 4.783, a discrepancy of 0.118 unit, or 2.5 per cent.

Repeating the Rousseau diagram with 10° zones as on the right-hand of Fig. 6, and computing the steps of the process as indicated in Table IV, we obtain the apparent mean spherical intensity of 4.7696, a result 0.0134 below the theoretical value, or 0.28 per cent.

The comparative analysis of the new diagrams and the Rousseau diagrams is collected in Table V.

The table indicates that with perfect geometry and scaling, the new diagram is somewhat superior in accuracy to the Rousseau diagram of equal breadth of zone. In regard to practical constructive accuracy, the advantage lies on the side of the new diagram, because the error of planimetry is avoided.



FIGS. 4 AND 5.—NEW DIAGRAMS OF CIRCULAR INTENSITY DISTRIBUTION, DIAMETER DEPRESSED 60° FOR 30° ZONES AND FOR 10° ZONES RESPECTIVELY.

Mean spherical intensities 4.515 and 4.79. Maximum 10. Theoretically correct mean spherical intensity 4.783.

Application of New Diagram to Determination of Spherical Reduction Factor.

As another example of the new diagram, Fig. 7 shows the rectification of the polar curve for a sample of regular oval anchored filament incandescent lamp as published in the *Bulletin*

of the Bureau of Standards.[3] The rectification is effected for zones of 10°. The mean horizontal intensity OH, being taken as unity, the mean spherical intensity $\frac{QQ'}{2}$ appears as 0.83 from the diagram, and this is therefore the apparent spherical reduction factor for the lamp under consideration. The spherical reduction factor mentioned in the paper is 0.826.[4]

TABLE V.

COMPARATIVE ANALYSIS OF ERRORS IN NEW DIAGRAM AND ROUSSEAU DIAGRAM.

Type of Polar Curve	Zone Breadth	Diameter of Circle	Mean Spherical Intensity. Rousseau Diagram: With perfect Geometry	Rousseau Diagram: Per Cent Error	New Diagram: With perfect Geometry	New Diagram: Per Cent Error	New Diagram: Actual Geometry Scaled from Diagram	New Diagram: Per Cent Error	Theoretical Value
Simple Circle	30°	10	7.5	−4.5	7.7645	−1.4	7.78	−0.9	7.854
Simple Circle	10°	10	7.814	−0.51	7.8443	−0.12	7.88	+0.33	7.854
Depressed 60° Circle	30°	10	4.665	−2.5	4.519	−5.5	4.515	−5.6	4.783
Depressed 60° Circle	10°	10	4.7696	−0.28	4.7882	+0.11	4.790	+0.15	4.783

Application of New Diagram to Determination of Absorption by Globes.

A further example of the use of the new diagram is shown in Fig. 8. On the right-hand side of the vertical VV' is the polar curve for a certain 16-cp incandescent lamp.[5] The mean spherical candle-power of this lamp is indicated by rectification to be 13.2, representing a reduction factor of 0.825. Of the total light emitted by the lamp, $\frac{12.95}{26.4}$ or 49 per cent is indicated as emitted in the hemisphere DCH to which the lamp base belongs, and 51 per cent in the hemisphere ABH containing the lamp tip. On the left-hand side of the vertical VV' is the polar curve given for the same lamp after being enclosed in a 6-in. frosted globe. The mean spherical candle-power of the combination is found to scale $\frac{VV'}{2} = 10.875$, representing a spherical reduction factor of 0.833, and a diminution in mean spherical candle-power, and in total light flux, by 17.7 per cent, due to absorption of light by the frosted globe. This deduction assumes that the globe and enclosed lamp radiated light as a virtual point-source. If a globe or reflector attached to a lamp causes the light to radiate otherwise than from a virtual central point as viewed from the photometer screen, it is needless to say that neither the term candle-power nor zonal candle-power properly applies to the combination except as apparent values under the particular conditions of observation. Neither the Rousseau diagram nor the new diagram applies without modification to such a case.

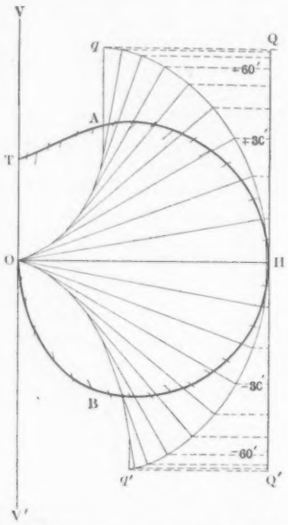


FIG. 7.—NEW DIAGRAM OF VERTICAL MERIDIAN INTENSITY DISTRIBUTION FOR A REGULAR SAMPLE OF OVAL ANCHORED FILAMENT INCANDESCENT LAMP, RECTIFIED BY 10° ZONES.

Mean horizontal intensity OH = 1. Mean spherical intensity = QQ'/2 = 0.83. See Bulletin of Bureau of Standards, December, 1907, Vol. 4, No. 1, p. 106, Fig. 7.

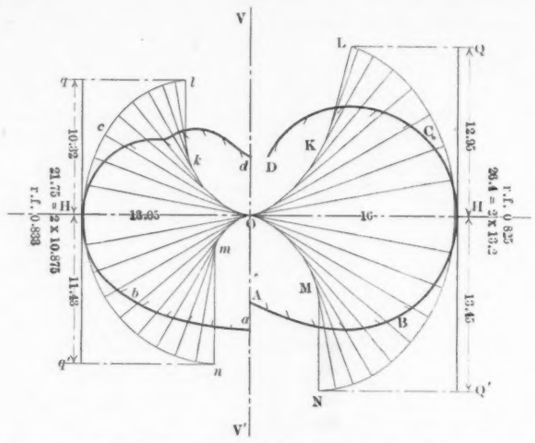


FIG. 8.—NEW DIAGRAM OF MERIDIONAL MEAN INTENSITY OF A NEW 16 CANDLE-POWER LAMP, FIRST SEPARATELY AND SECOND AFTER BEING ENCLOSED IN A 6-IN. FROSTED GLOBE.

Mean spherical candle-power 13.2 and 10.875, respectively. Rectification by 10° zones. See Transactions of the Illuminating Engineering Society, April, 1907, Vol. 2, No. 4, p. 216, Fig. 7.

Particular Case of New Diagram Applied to a Simple Luminous Point Source.

It will be seen from Figs. 1, 2, 4, 5, 7 and 8 that the greater the irregularity between the various radii vectores of the polar curve, the longer the evolute will generally be. Oppositely, the more nearly a polar curve conforms to uniform radius the shorter the evolute. In the particular case of a simple luminous point source, having equal intensity in all directions, as indicated in Fig. 9, the evolute vanishes and the involute coincides with the polar curve. The vertical axis of the curve is then equal to QQ' and the mean spherical intensity becomes equal to HQ or to the uniform polar radius, as should obviously be the case. This simple condition and diagram assists the mem-

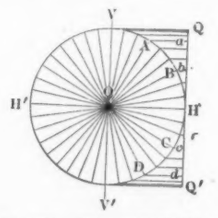


FIG. 9.—NEW DIAGRAM FOR THE PARTICULAR CASE OF A POINT SOURCE OF UNIFORM INTENSITY IN ALL DIRECTIONS. EVOLUTE VANISHES.

The mean spherical intensity is QQ'/2 = HQ = uniform radius.

3. Bulletin of the Bureau of Standards, December, 1907, Vol. 4, No. 1. "A Comparative Study of Plain and Frosted Lamps," by Edward P. Hyde and F. E. Cady, Fig. 7, page 106.

4. loc. Table II, page 100.

5. Transactions of the Illuminating Engineering Society, April, 1907. P. S. Miller, Fig. 7, page 216.

ory to retain the construction of the new diagram for the ordinary case where an evolute and an involute present themselves.

Theory of the New Diagram.

If we consider the fundamental formula (1) for mean spherical intensity, we may apply it to, say, zones in each hemisphere, or zones in all, as follows:

$$2I_m = \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} I_\theta \cos\theta\, d\theta = \int_{-\frac{\pi}{2}}^{-\frac{\pi}{4}} I_\theta \cos\theta\, d\theta + \int_{-\frac{\pi}{4}}^{0} I_\theta \cos\theta\, d\theta + \int_{0}^{\frac{\pi}{4}} I_\theta \cos\theta\, d\theta + \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} I_\theta \cos\theta\, d\theta \quad (3)$$

In each of the four zonal integrals we may, without serious error, substitute for the variable I_θ a constant I which is the value at the midzone. We thus obtain:

$$2I_m = I \int_{-\frac{3\pi}{8}}^{-\frac{\pi}{4}} \cos\theta\, d\theta + I \int_{-\frac{\pi}{8}}^{0} \cos\theta\, d\theta + I \int_{+\frac{\pi}{8}}^{\frac{\pi}{4}} \cos\theta\, d\theta + I \int_{\frac{3\pi}{8}}^{\frac{\pi}{2}} \cos\theta\, d\theta \quad (4)$$

It will be found by inspection of a 45°-zone new diagram, that it effects, on the line of projection, the summation of the four integrals on the right-hand side of (4). The greater the number of correspondingly reduced zones selected, the more nearly does $I_{\theta+a}\int_{\theta}^{\theta+2a} \cos\theta\, d\theta$ approach the value of $\int_{\theta}^{\theta+2a} I_\theta \cos\theta\, d\theta$ and, in practice, it is found that 9 zones of 20 deg. each, are a satisfactory number for the ordinary degree of accuracy desired.

CONCLUSIONS.

The new graphic method for evaluating the mean spherical intensity of a lamp directly from its polar curve, above described, expresses the result as a straight line. It performs the same function as the Rousseau diagram; but dispenses with the planimeter, requiring only compasses and protractor. It possesses theoretically at least as great a degree of accuracy as the Rousseau diagram, for a given number of zones. It gives at a glance the upper and the lower hemispherical intensities, the mean of which is the mean spherical intensity. It further enables the luminous flux through any zone, per radian of azimuth, to be read off directly from the line of projection. It has been found practically useful.

Square-Core and Round-Core Windings.

BY CHARLES R. UNDERHILL.

IN the calculation of windings for electromagnets with cores of square or rectangular cross-section, the form of the winding is generally assumed to be as shown in Fig. 1, and its cross-sectional area is calculated accordingly. That this method is very impracticable will be appreciated by any engineer who may have calculated a winding by it and compared the actual characteristics of the wound coil with his theoretical deductions.

Most text-books express the volume of such a square-core winding by the formula

$$V = L\,(B^2 - a^2) \quad (1)$$

in which a and B are as in Fig. 1, and L is the length of the coil. It would be an extremely difficult operation to cause all the turns to form perfect squares, as this would be possible only with exceedingly fine wires.

All practical square-core windings, such as are used on field magnets, etc., appear as in Fig. 2. This is perfectly natural, since the tension on the wires during the winding process tends to press the layers closely together at the corners; hence, the thickness or depth (T) of the winding will be uniform all

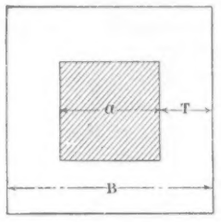


FIG. 1.—IMAGINARY SQUARE-CORE WINDING.

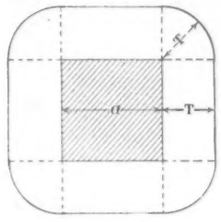


FIG. 2.—PRACTICAL SQUARE-CORE WINDING.

around the core, excepting at the sides, where it has a tendency to bulge outward owing to the resiliency of the wire and the lack of pressure on the flat faces. This latter effect, however, need not be considered in this article.

For a given thickness of winding and length (L), the volume of a winding and consequently the resistance, will vary as the average perimeter (P_a) of all the turns. Hence, the volume of any form of winding may be expressed by

$$V = P_a L T \quad (2)$$

For a practical square-core winding, as in Fig. 2,

$$P_a = 4\,(a + .7854T) \quad (3)$$

Assuming $T = \frac{a}{2}$, approximately 7 per cent less wire will be required in the practical type (Fig. 2), than in the imaginary winding (Fig. 1), to accomplish the same results with the same size of core, wire and number of turns. This is due to the decrease in the average perimeter of the winding, in the practical type. For a given size of wire, the resistance will vary directly with the average perimeter, the number of turns remaining constant. Hence, the voltage required, for fixed ampere-turns, will vary directly with the average perimeter.

As a matter of fact, the cores of this class of electromagnets usually have their sharp edges rounded off. We may then consider Fig. 3 to be a fairly accurate representation of the cross-section of windings of this nature. An inspection of Fig. 3 will show the average perimeter of the winding to be

$$P_a = \pi\,(T + 2r) + 2\,(a - 2r) + 2\,(b - 2r) \quad (4)$$

or, $$P_a = 2\,(a + b) + \pi T - 1.717r \quad (5)$$

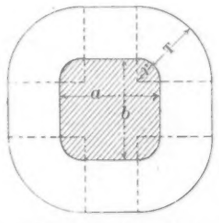
for windings with cores of square or rectangular cross-section. Since for square-core windings, $a = b$, (3) may be written

$$P_a = 4a + \pi T - 1.717r \quad (6)$$

or $$P_a = 4\,(a + .7854T - .429r) \quad (7)$$

(7) also holds for circular windings, as in Fig. 4, when $a = 2r$.

The external dimensions of the winding (excluding the



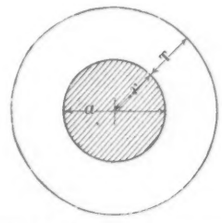


FIG. 3.—WINDING AND CORE BETWEEN SQUARE AND ROUND. FIG. 4.—ROUND-CORE WINDING.

length L) may be considered as secondary functions in calculating the m. m. f.; but as they determine the radiating surface, they will enter into the calculation of the electrical power which may safely be used with the winding. This will also depend largely upon the activity of the winding.

In most cases, the space for the winding is of such a nature that the latter may be either square or circular in cross-section.

The dimenson B will, therefore, be the limiting dimension for either form of winding; consequently, it is important to determine what form of core and winding will give the best results for any particular case.

For equal areas, the perimeters of the circle and square are to each other as 1:1.128. Hence, if it were possible to construct a winding whose thickness or depth would be zero, the economy of the round-core magnet would be 12.8 per cent greater than that for the square-core magnet. However, the

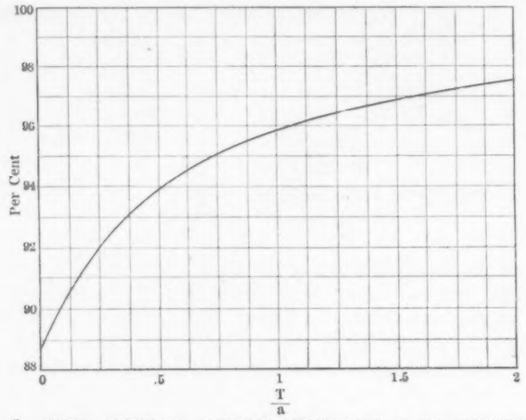


FIG. 5.—RATIO BETWEEN OUTSIDE DIMENSION B OF SQUARE-CORE ELECTROMAGNETS, AND OUTSIDE DIAMETER OF ROUND-CORE ELECTROMAGNETS.

thickness of the winding changes the ratio of average perimeters; thus, in two windings, one with a core 1 cm square, and the other with a round core 1 sq. cm in cross-section, the thickness of each winding being 10 cms, the economy of the round-core winding would be only 1.3 per cent greater than that with the square core. Therefore, for equal areas, when $T = O$, the round-core winding has the maximum economy; but, when $T = \infty$, the economies of the square-core and the round-core windings would be the same.

The dimension a, however, will be 12.8 per cent greater for the round core than for the square core. This will greatly increase the outside dimensions of the finished coil where a round core is used, providing, of course, that the thickness of the winding is not great as compared with a. Fig. 5 shows this relation, outside dimension B being compared, for equal core areas, with the outside diameter of the round-core winding. In

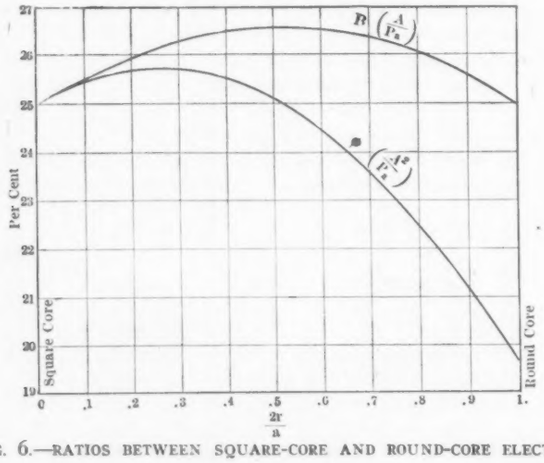


FIG. 6.—RATIOS BETWEEN SQUARE-CORE AND ROUND-CORE ELECTROMAGNETS WHEN $\frac{T}{a} = 0$.

this particular case, the value of a for the square-core winding is taken, in order to have the winding thickness the same for both the square-core and round-core windings.

On the other hand, if we make the dimensions a constant for both forms of cores, and the thickness of the winding equal to $10a$, the average perimeter of the square-core winding would be 2.5 per cent greater than that for the round-core winding, but the cross-sectional area of the square-core would be 27 per cent greater than that for the round core.

In any case, the flux density per square centimeter is expressed by the well-known formula

$$\mathcal{B} = \frac{4\pi A\mu In}{10l} \qquad (8),$$

wherein A is the cross-sectional area of the core in square centimeters; μ the permeability; I the current in amperes; n

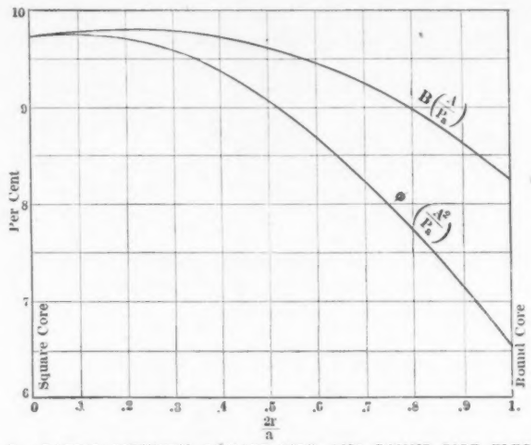


FIG. 7.—RATIOS BETWEEN SQUARE-CORE AND ROUND-CORE ELECTROMAGNETS WHEN $\frac{T}{a} = 2$.

the number of turns of wire in the winding, and l the length of the magnetic circuit. The ampere-turns may be expressed by the formula

$$In = \frac{E}{\rho P_a} \qquad (9),$$

wherein E is the voltage across the terminals of the winding and ρ the resistance, in ohms, per unit length of wire.

Substituting the value of In from (9) in (8)

$$\mathcal{B} = \frac{4\pi A\mu E}{10l\rho P_a} \qquad (10)$$

Assuming μ E, l and ρ to be constant, the value of $\mathcal{B}$ will vary directly with the ratio

$$\frac{A}{P_a}.$$

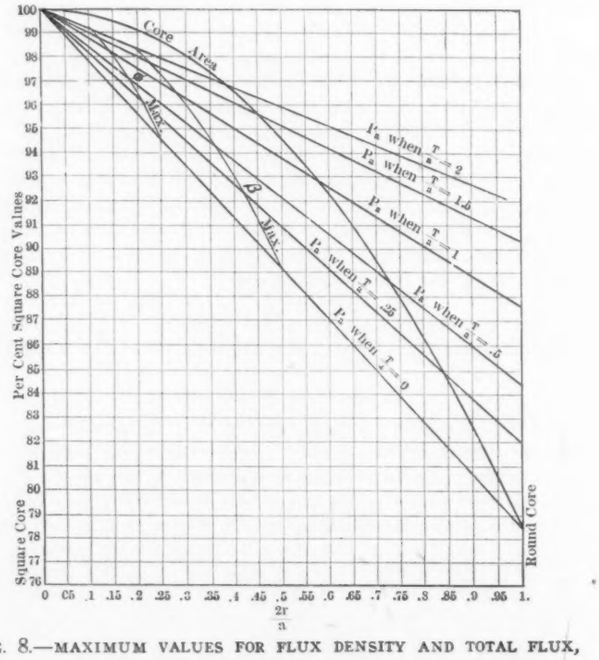


FIG. 8.—MAXIMUM VALUES FOR FLUX DENSITY AND TOTAL FLUX, AND RATIOS BETWEEN CORE AREA AND AVERAGE PERIMETERS.

While the practical round-core electromagnet has the greater economy, magnets with square cores are, nevertheless, exten-

sively used. When the dimension a of the core, and the outside dimension B, of a square-core electromagnet, are fixed, its economy may be considerably increased by rounding the corners of the core, as in Fig. 3.

It will be seen that by increasing the value of r from 0 to $0.5a$, the square core, by gradual transition, becomes perfectly round, a remaining constant. It is, therefore, obvious that for various ratios of T and a, the core and winding for maximum economy will fall somewhere between the square core and the round core.

In Fig. 6 is shown the ratios of $\frac{A}{P_a}$ for flux density, and $\frac{A^2}{P_a}$ for the total flux, when $\frac{T}{a} = 0$. Fig. 7 shows the relations when $\frac{T}{a} = 2$. The maximum values for $\mathcal{B}$ and ϕ are shown in Fig. 8. The values of μ, E, l and ρ, as before stated, are assumed to be constant. The dimension a is also assumed to remain constant, while the values of r and T are variable. This shows the ratios of the various average perimeters and core areas, taking the cross-sectional area of the square core as unity for the core areas, and the average perimeter of the square-core winding as unity for the average perimeters.

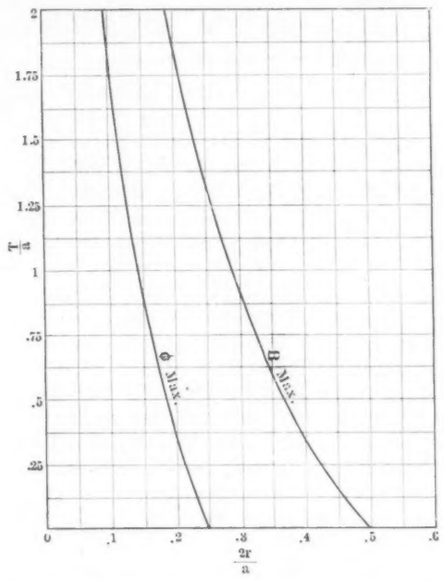


FIG. 9.—MAXIMUM FLUX DENSITY AND TOTAL FLUX, FOR VARIOUS VALUES OF $\frac{2r}{a}$ AND $\frac{T}{a}$

When $\frac{T}{a} = 0$, $a = \mathcal{B}$, hence the maximum core area will be obtained with the square core. The round-core winding, however, has the minimum average perimeter; and as the ratio between core area and average perimeter is the same, the value of $\frac{2r}{a}$ which will produce the maximum flux density will be found to be 0.5. The condition which shall produce the maximum flux is met when $\frac{2r}{a} = 0.25$.

The proper value of $\frac{2r}{a}$ to produce maximum results for practical windings will be found at the points where the flux density, or the total flux curves, intersect with the average perimeter curves. This relation is shown more clearly in Fig. 9.

The usual insulation between the core and the winding has not been considered. However, the average perimeter of the winding may be compared with the total cross-sectional area of the core, plus the insulating medium, and corrections made for the difference between the actual and assumed core areas. In any case, it is important that the average perimeter shall be calculated for the actual winding only.

Minneapolis Light and Power Rates.

During the recent controversy over the question of electric light and power rates to be charged by the Minneapolis General Electric Company under its new franchise, a report was made by Mr. Charles L. Pillsbury, a consulting engineer of that city, in behalf of citizens who were anxious to get at the true status of the matter before rates were agreed upon. Mr. Pillsbury's report, entitled "Rates and Methods of Charge for Electric Light and Power as Applying to the Minneapolis General Electric Company," has been printed and forms a very comprehensive document on the subject of equitable rates, and in view of the increasing interest being shown in electric lighting rates the country over, it is of timely value, through clearly setting forth sound theories on the rate question and exploding some of the popular misconceptions which, as was the case at Minneapolis, have given rise to very ill-advised legislation. The original franchise offered to the Minneapolis General Electric Company required a uniform rate of 8 cents per kw-hour to all consumers, with discounts according to quantity only. The unfairness of this system both to consumers and public is well brought out in the report. Incidentally it may be said that Mr. Pillsbury's report is in accordance with the findings of probably every board of experts which has passed upon the rate question for the past 10 years.

The report first takes up the elements entering into the costs of production and distribution of electricity and brings out the large plant capacity required and the small number of hours per year that this is in use. The excessive plant capacity required is illustrated by the published statement of the Edison Electric Illuminating Company of Boston to the Massachusetts Board of Electric Light Commissioners, to the effect that during the year 1906 one-half of the plant did approximately 97 per cent of the work; the other half being required to do the 3 per cent of business which came at the time when the greatest number of lights are called for during the winter season. Now since the fixed charges constitute a large percentage of the total cost of production and distribution, it is evident that the total costs per unit of output will decrease rapidly as the output of any given plant is increased by longer hours of average use of electricity. To illustrate this principle, the report presents an example of a small high-grade steam-driven plant of a capacity of 400 kilowatts located in a small city and provided with a fully-equipped overhead distribution system. The cost of the plant is assumed to be $100,000 or $250 per kilowatt of plant capacity. This report then gives the fixed expenses not proportional to the output as follows:

Depreciation, 5 per cent	$5,000
Taxes and fire and liability insurance, 2 per cent	2,000
Salaries, legal expenses and fixed labor	8,000
Other fixed expenses	1,000
Total fixed expenses	$16,000

The plant, if worked at full load every hour in the year, would generate 3,504,000 kw-hours. Dividing this into the fixed expenses of $16,000 would make the fixed charge 0.456 cent per kw-hour. Assuming that the variable expenses proportional to output, such as fuel, variable labor, variable maintenance, etc., are 2 cents per kw-hour, the expense of output generated 24 hours per day would be 2.456 cents per kw-hour. If, on the other hand, the total yearly output should only be equivalent to one hour's average daily use of the plant and corresponding to a yearly load factor of 4.17 per cent, the fixed expenses, not including interest or dividends on investment, would be 10.958 cents per kw-hour, and the total expenses 12.958 cents. If only one half hour's use is made of the station per day, the fixed expenses are 21.84 cents per kw-hour. He then shows the great difference between the cost of production and distribution to different consumers as figured on this basis and the uniform rate per kw-hour to all consumers without regard to hours' use per year, which was proposed by the first ordinance. The argument is frequently put forth that in a plant having many customers, their demands do not coincide. It is evident that as regards lighting many do coincide. Statistics show that the station-lighting demand represents about one-third of the sum

of the customers' lighting demands. These facts indicate clearly that so far as cost to the company is concerned, the load factor (or the ratio of the average to the maximum load) is of tremendous importance; and if customers are to be billed in proportion to the costs of the service rendered, the customers' load factor must be taken into account in fixing the rates.

The report then takes up the question of whether rates closely following the costs to the central-station company would enable the company to meet competition with private plants. Obviously, no rates should be adopted which would tend to prevent a company from taking on all such business as it can at a profit. Such business tends to swell the total volume and to decrease the average costs, and therefore the average rates to all consumers. A system of rates which would prevent the company from taking on any of such profitable business or which would compel the company to give secret special rates differing from the schedule in order to obtain it, would be pernicious in the extreme. After analysis Mr. Pillsbury finds that the rates properly based on the customer's demand or load factor not only follow the line of cost to the company, but also the line of costs of competitive isolated plant service.

He then shows that power rates can justly be made lower than lighting rates. The difference between the station power demand and the sum of the consumers' power demands is much greater than in the case of lighting. Further, there are lamp renewals and the necessity of high-grade voltage regulation. An equitable system of rates should take into account the load factors of the customers, the lower cost of service for power, and the slightly lower cost of service for large quantities.

The report presents a synopsis of the rates charged in 33 American cities. A careful analysis shows that fundamentally but five systems are represented, namely:

1. Uniform meter rate per kw-hour.
2. Uniform meter rate with step system of discounts varying with quantity used.
3. Uniform meter rate with block system of discounts varying with quantity used.
4. Readiness-to-serve method.
5. Maximum-demand system.

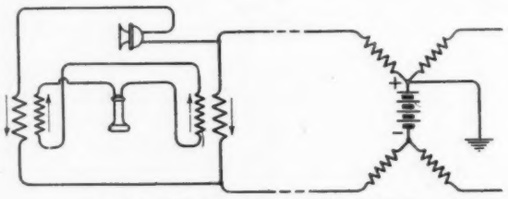
The first he considers so utterly impracticable as to be unworthy of any consideration. The second is not based on scientific analysis of cost of production, cannot result in a uniform percentage of profit and represents only arbitrary sale values. This system is rapidly going out of use. The block system of discounts, where reduced rates apply to certain consumption in excess of that used at the higher rate, is commercially more desirable than the step system, but unduly discriminates in favor of large consumers. The readiness-to-serve system is probably scientifically correct, but imposes a rather heavy minimum charge and high rate to very short-hour users of current. The maximum-demand system is used in 14 of the cities listed. It usually consists of two meter rates, a higher or primary rate, applying to all consumption up to an amount equivalent to certain stated average daily hours' use of the maximum current, and a lower rate applying to all excess consumption. The consumer does not get the benefit of the lower rate until he has taken sufficient current at the higher rate to reimburse the company for the use of that proportion of its total capacity reserved for him. Mr. Pillsbury favors this system. Practically the only valid objections to the demand system are difficulty in getting the public to understand the rate and method of computation, and chance for error in determining the demand for which the rate is to apply.

The report then takes up the plants of the Minneapolis General Electric Company. The 10,000-kw water-power station at Taylor's Falls is not yet on a paying basis. Mr. Pillsbury estimates that for the coming year the expenses independent of output will amount to 60 per cent of the total, those proportional to output being 40 per cent. He recommended that the lighting rates proposed by the company for the first year of its new franchise be adopted, these being 10 cents for the first 52 hours' use of the equivalent of the customer's maximum demand, and 6 cents for current used in excess of that. As noted in these columns in the issue of March 7, the committee of the Council and the company came to an agreement Feb. 25 on the rates to be charged for the first year of the company's franchise. These rates, with the prompt payment discounts taken off, are as follows: Residence lighting, 9 cents per kw-hour for the first 52 hours' use per month of 40 per cent of the installation, and 6⅔ cents per kw-hour for all current in excess. Commercial lighting, 9 cents per kw-hour for the first 52 hours' use per month of the customer's maximum demand, and 6⅔ cents for all current used in excess. The customer's demand is to be determined by monthly demand meter readings. Retail power, 7½ cents per kw-hour for the first 52 hours' use per month of the customer's maximum demand, and 2½ cents per kw-hour for all current used in excess, the customer's demand in all cases to be determined by meter readings. The minimum rates are $1 per month per meter for lighting customers and $1 per horse-power per month on the rated capacity of a customer's installation for power. The above rates do not include lamp renewals or maintenance. There are quantity discounts of from 5 to 25 per cent on bills ranging from $50 to $250 per month.

New Telephone Patents.

"AUTO-SIDE TONE" CIRCUIT.

The telephone is now so familiar to all that many of the peculiarities of its operation for a long time known only to the telephone fraternity are now recognized generally. In this category may well be included "side tone" or that excitation of a receiver coincident with the use of its own associated transmitter. This side tone has long been of use to telephone troublemen, its volume affording a fair indication of the condition of the telephone set or even, under certain circumstances, of the condition of the line and the distance to its faults. On the other hand, as the service demands in long-distance work have gradually grown, this side tone has proved detrimental. The reason lies in the comparatively great volume of the side tone as compared to the volume received from the distant end. For a considerable time there have been in service side-tone reduction sets of more or less efficiency. A new arrangement has now been patented by Professor Morgan Brooks, of Champaign, Ill. He has devised several plans for different systems, but for illustration that shown below will suffice. This is a



BROOKS "AUTO-SIDE TONE" CIRCUIT.

common-battery system. It will be noted that two induction coils are required. These are so poled that when currents are generated due to the action of the transmitter, these currents will neutralize each other in the local receiver circuit. For example, suppose current flowing in the primaries as indicated by the arrows, and assume the transmitter resistance increased suddenly. There will at once be a diminution in the current in one primary and there will be an increase in that in the other. These changes must produce approximately neutralizing currents in the secondaries. For incoming currents the primaries, of course, work together, as they are in parallel.

STATION CIRCUIT.

When two coils are wound together, the wires lying in close proximity for a considerable part of their length, the result is a very fair condenser, the two windings serving as the plates. When these windings are those of a telephone, this telephone will respond to currents from a circuit connected to the two windings, provided that the charges flowing into windings have a cumulative inductive effect in the coils. Messrs. C. M. Jacobs, of Reading, England, and W. J. Thorrowgood, of Wimbledon

Park, England, have recently patented circuits employing such instruments. In these circuits the receiver is in parallel with the induction coil secondary, which latter is included in the single-wire line, such as a telegraph line. The receiver may have a condenser in series with it with a leg to ground connected between this condenser and the receiver. It is found by the inventors that telegraph currents normally passing in the line are most inefficient in their effects upon a phonophore receiver, and therefore the telegraph currents can be tolerated while the telephones are in use.

LETTERS TO THE EDITORS.

Looping vs. Cutting Theories of Electromagnetic Induction.

To the Editors of Electrical World:

SIRS:—Concerning your comments on page 543 in your issue of March 14, 1908, under the heading "Looping Versus Cutting Theories of Electromagnetic Induction" you seem to cast some doubt upon the sufficiency of the cutting conception when it is applied to "closed or nearly closed magnetic circuits." In reality, there is no trouble with the conception, even in this case, if properly applied. Of course, the conception itself is merely a symbol or representation of something which occurs and which conception or symbol involves the idea of Faraday of magnetic lines cut by conductors; lines which tend to shorten themselves, and which are mutually repellant laterally. It was for the purpose of showing the sufficiency of the line-cutting conception that I wrote a paper on "Magnetism in Its Relation to Induced E.M.F and Current," which was read before the American Institute of Electrical Engineers at the meeting of May 22, 1889, and which, of course, appeared in the *Transactions later*. It was also published in the ELECTRICAL WORLD dated July 1, 1889. To this paper I would refer anyone who has felt that the line-cutting idea is insufficient for all cases of magneto-electric induction.

WEST LYNN, MASS. ELIHU THOMSON.

To the Editors of Electrical World:

SIRS:—As I understand Mr. Hering's drawing and statements in his article in your issue of March 14, he considers that the current flows from brush to brush in a confined direct line, and that the magnetic flux is projected perpendicularly through the copper strip *C* at a point directly in line with the two brushes *B B* across the proposed line of current. Now, if I am right as to this understanding, I wish to state my views in the matter.

When the two brushes contact, as shown, at the two opposite edges of the strip and midway of the strip's length, the current from brush to brush would *not* confine itself to the assumed path, but would, instead, travel the entire length of the strip for the width of its path; it could, so to speak, be likened unto a multitude of filaments of divided current branching at the brushes, spreading and coupling across the strip. When the strip is moved endwise these spread-out paths of current still exist, notwithstanding that the contact-position of the brushes are shifting along the strip. Now, in view of the width of current-path being greater than the width of the flux-path, there is effected a changing of current interlinkage with the flux as the strip is moved along between the brushes and across the position of the magnet.

As to preference for the cutting or the interlinking-stress hypothesis, I prefer the latter as affording the better concept as to what happens mechanically, because, if we will consider a number of loosely bunched conductors carrying one-way current, there is developed around this bunch a magnetic girth that draws these current-bearing wires together into a more compact mass, apparently in consequence of the tendency for this encompassing magnetic path to shorten by its pronounced tension.

I would suggest considering this contractile feature also in connection with Mr. Hering's "pinch" phenomena announced in your pages some time ago.

In an old number of *Blackwood's Magazine* the corelation of current to magnetism was expressed in the following terms:

Around the magnet, Faraday
Is sure that Volta's lightnings play;
But how to draw them from the wire?
He took a lesson from the heart—
'Tis when we meet, 'tis when we part,
Breaks forth the electric fire.

This verse would indicate Faraday as advocating the linkage-stress idea. It does really seem as though current and flux mutually avoid tenanting the same place, although each endeavored to embrace the other.

PHILADELPHIA, PA. H. C. HECKENDORN.

To the Editors of Electrical World:

SIRS:—In the article by Mr. Carl Hering, in your issue of March 14, Maxwell is quoted as follows:

On page 559 at the bottom of the first column: "The whole of these phenomena may be summed up in one law. When the number of lines of magnetic induction which pass through the secondary circuit in the positive direction is altered, an e.m.f. acts round the circuit, which is measured by the rate of decrease of the magnetic induction through the circuit"; and in order that Maxwell may not have to bear the brunt of the attack alone J. J. Thomson is also quoted in words to the same effect.

Now I think I am right in maintaining not only that this rule, *precisely as it is stated* by these two authorities, is exactly correct, but also that it is universally applicable to problems involving induced e.m.f. The argument of Mr. Hering to the contrary falls to the ground for the following reasons: First, he uses the word "circuit" in a way different from that in which it is used in the looping rule, for he considers that a portion of a loop (his term "open circuit" must surely, in its simplest form, mean a portion of a loop) may be called a circuit. Now the law he is discussing speaks of tubes of induction "which pass through the circuit," and unless the word circuit be taken to mean a complete loop, the expression "passing through the circuit" has no definite meaning. The term "open circuit" is a term commonly used, but I think that strictly speaking we have no experience of any such thing as an "open circuit." In the way in which it is commonly used the term "open circuit" means a circuit one section of which possesses a very high resistance and (usually) a very small capacity. When applied to such a circuit as this the looping rule is quite satisfactory. The rule is, as is obvious from the form of its statement, only applicable to complete circuits and not to portions of circuits. A little thought always enables it to be applied to some circuit the e.m.f. induced in which will be due entirely to any particular portion it may be necessary to consider, and in this way the e.m.f. due to that "portion" may be determined.

Mr. Hering next considers that a circuit, one section of which is being constantly replaced by a new section, can be looked upon as always one and the same circuit. In the figure on page 559 the section represented by the dotted line is, during movement of the strip, continually being renewed. Had he taken account of this fact, I think Mr. Hering would have seen that there is indeed a *rate of change of the flux passing through each instantaneous circuit.*

The experiment spoken of in the middle paragraph of the second column of page 559 consists essentially in taking a C-shaped conductor, a copper plate and a round bar-magnet. The copper plate is glued on to the flat end of the magnet and this copper-plated bar-magnet is then passed between the horns of the C-shaped conductor. It "may not be generally known," says the author, "that there will not be any induction whatsoever." And yet to some of us it would seem to require a very wild imagination to think that there possibly could be

any induction; for both the looping and the cutting rules at once show that there is none.

In closing Mr. Hering says: "It cannot be disputed that the loop or linking law *does not* instruct us what the result in that experiment will be." To my mind, however, it most certainly can be disputed, for the linking law predicts the result of the experiment in precisely as clear a way as does the cutting law.

In the editorial commenting on Mr. Hering's article, when speaking of the e.m.f. induced in the bars of a direct-current machine with slotted armature core, doubt is cast upon the possibility of arriving at a result by the cutting rule. Now when a conductor sweeps over a pole face it is obvious that it must cut through all the lines of force that emanate from that pole face. And that this must be so no matter what antics the lines of force may go through in attempting to avoid being cut. It is, of course, true that the density of the lines within the slots is much less than that in the teeth. The fact, however, has been neglected that the speed of cutting of the flux is greater in a slotted than in a smooth-cored armature. In the case of a smooth-cored armature the flux may be regarded as stationary while the bars move, but in the case of a slotted core *both flux and bars are in motion*. Underneath any given point on the pole face there exists at one moment a tooth and at the next moment a slot. The tooth demands a high density, while the slot demands a low density. Hence the density at the point of the pole face considered is changing. The lines must therefore be regarded as in motion relatively to the pole face.

In the last paragraph of the editorial on page 543 it seems to be implied that the cutting conception of induced e.m.f. applies only to conductors. Now it is easily shown that the magnitude of the e.m.f. produced when a conductor cuts lines of force is independent of the resistance of that conductor, and there seems to me to be no reason to think that the e.m.f. would not still be the same even if the thing cutting the lines of force had an infinitely high resistance and were therefore what is called a non-conductor.

As regards the e.m.f. induced in the coils of a transformer, I personally have always found that the cutting rule serves to give to a student an excellent physical conception of what takes place, and I am a loss to know how the method can be held to fail.

In conclusion I should like to say that I quite agree with Mr. Hering in considering that it is generally better to emphasize the cutting rather than the looping rule, although the one is the precise equivalent of the other. The first involves a "rate of cutting," the conception of which seems to be easy to a student, while the other involves a "rate of change," and this seems to be a conception that is by no means so easy. Especially does it seem difficult for a student to realize that a quantity whose value is *naught* may nevertheless have a rate of change whose value is not naught.

Pittsburg, Pa. Frank M. Denton.

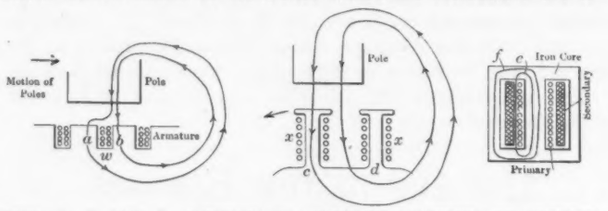
To the Editors of Electrical World:

Sirs:—In the editorial comments on the article by Mr. Carl Hering in the issue of March 14, the statement is made that in machines in which the conductors are embedded in the iron, such as tooth armatures and transformers, the "cutting theory" does not hold, and we are forced to the "link" hypothesis.

It seems to me that the cutting theory holds absolutely for these cases, as well as it does for the cases mentioned by Mr. Hering, provided one keeps in mind the fundamental conception of a "line of force" as expressed by Faraday, namely, that it is always a *closed circuit* or *loop*.

With this exception in mind, and referring to Fig. 1, one can readily see that in order for a line of force to get from the position *a* to the position *b*, it must cut the embedded wires *w* if the loop continues intact. Referring to Fig. 2, which shows a pole-type of armature, in order for the pole *d* to take the place of the pole *c*, it is necessary for the wires *x* to cut into and out of the line of force. The same argument holds for transformers. It is clearly evident in Fig. 3 that in order for a line of force to move from position *e* to position *f*, it must cut the conductors if the line of force remains a closed loop.

With this conception of a line of force in mind, it may be stated that it makes no difference where the conductors are located, whether in free space on the surface of some magnetic material or totally embedded in magnetic material, provided that in our calculations we take the actual number of lines of force which *cut* the conductors.



FIGS. 1, 2 AND 3.—LOOPING VS. CUTTING THEORIES OF ELECTRO-MAGNETIC INDUCTION.

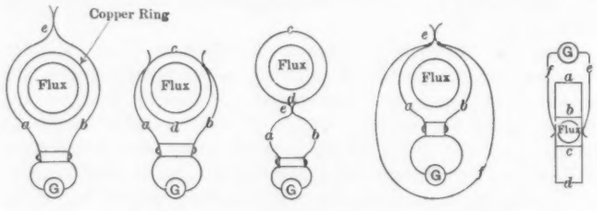
Wilkinsburg, Pa. A. B. Reynders.

To the Editors of Electrical World:

Sirs:—While I do not feel myself qualified to enter with Mr. Hering into a discussion as to whether Maxwell's or Faraday's interpretation of the law of magnetic induction is the more general, I do wish to question what Mr. Hering has proved by means of his "crucial" experiment, described in the March number of the *Proceedings* of the A. I. E. E. and to which he refers in his article in your issue dated March 14. I have tried to analyze what the experiment accomplishes; whether or not, by such means as he describes, we can actually link or unlink a circuit with some magnetic lines, and yet have no e.m.f. induced in that circuit.

I consider that phase of his experiment wherein he has a circuit made up of two springs, some wire and a galvanometer, already linked in the field of an excited solenoid, around which solenoid is placed a copper ring. From Fig. 1 we see that the circuit which is going to be manipulated, consists of two springs, *a* and *b*, their point of contact *e*, and the wire connecting the springs to the galvanometer, together with the galvanometer itself. We will see what happens when this circuit is unlinked from the magnetic field.

Suppose that the operation has been partially completed, and we have the circuit as shown in Fig. 2. The original circuit has now had introduced into it another part, the copper ring, which part consists of two paths in parallel; one path *c*, combined with the original circuit, still encloses the flux, but that circuit consisting of the original one and the path *d*, through the ring, *does not* enclose any flux; and here is where the fallacy of Mr. Hering's argument appears to lie. By means of the path *d* we have short-circuited that part of the original circuit which encloses the flux.



FIGS. 1, 2, 3, 4 AND 5.—LOOPING VS. CUTTING THEORIES OF ELECTRO-MAGNETIC INDUCTION.

Following the operation still further, we see that the last step gives us three paths in parallel, as shown in Fig. 3. Two paths, *d* and *c*, exist through the ring and a third through the point *e*, where the two springs come in contact. When the springs are further removed, that path *c*, which is necessary to form a circuit still enclosing the flux, is cut off altogether from our original circuit. That no current would be forced through the galvanometer during this operation could have been safely predicted, and the labor of performing the experiment saved.

The writer wishes to suggest to Mr. Hering that if he wishes to perform the experiment again, a simple way of doing it would be to attach a wire, *f*, to the springs as indicated, then open the springs, draw them over the solenoid, let them come together again, and remove the wire. This accomplishes exactly the same thing as his experiment, and proves the same thing with regard to the question he is considering—nothing.

Referring to the figure given in connection with his article, we see that the same fallacy exists here as in the experiment just considered. The copper plate used, forming part of the circuit of the galvanometer, might be made up, for simplicity, of four wires, *a*, *b*, *c* and *d*, connected together at their ends. We can now readily see that it is impossible to say that the flux is linked with the galvanometer circuit or the reverse. The word circuit now is ambiguous; does the galvanometer circuit now consist of *e*, *d*, *f*, or *e*, *a*, *f*? In the former case, the flux is already linking the circuit, while in the latter, it does not. If we should now increase the number of wires, *a*, *b*, *c*, *d*, indefinitely, we would have the equivalent of the copper plate. We can only say that the flux is linked with the galvanometer circuit when it is included in the circuit *G*, *e*, *a*, *f*, and that the flux does not link the galvanometer circuit when it is outside the circuit *G e d f*.

PRATT INSTITUTE, BROOKLYN. J. H. MORECROFT.

To the Editors of Electrical World:

SIRS:—In your issue of March 14 you refer to the method of expressing Faraday's law of induction, and show that as applied to Hering's experiment, Faraday's statement is correct.

This is undoubtedly the true statement of the law, and the method of counting the number of lines of induction enclosed by the coil at the beginning and end of the time is simply a convenient but not very illuminating method, for finding the number of lines that have cut the circuit. When anyone can devise a method, as Mr. Hering has done, for getting the lines out from the circuit without cutting the conductor, the method fails. It is well to emphasize the fact that it is the cutting that produces the e.m.f. as Mr. Hering has done.

As to the iron-clad armature, there is no serious difficulty. The wires are in a weak field, and, therefore, do not feel a great pull, but in the motion of the armature, all the lines that are surrounded by the wire are pulled out of that connection, collapsing quickly by virtue of their own elasticity as soon as they leave the iron. It will be evident that they must all cut the wires when it is remembered that they never have any free ends and cannot get out of their surrounding coil without cutting it—unless one should use some device similar to that of Mr. Hering.

Again as to the disturbances in the air, the same e.m.f. is set up in a string as in a copper wire, and as much e.m.f. is exerted on the air surrounding lines of induction as in one turn of copper wire. In the air, however, only a convection current is produced, unless, as in the upper atmosphere, the air itself is a conductor. But in the displacement currents, which constitute light waves, there seems to be no reason why the currents and lines of induction should not be linked together just as they are in the armature of a dynamo. Maxwell's theory assumes such linking, though the mental conceptions may not be as easy to form in this case as in that of the dynamo.

UNIVERSITY OF TENNESSEE. CHAS. A. PERKINS.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Direct-Current Turbo-Generators.—W. HOULT.—The usual methods for obtaining a fixed brush position in direct-current turbo-generators are either by means of compensating windings, or by commutation poles, or by a combination of both these methods. With compensating windings alone, sparking due to distortion is prevented, but that due to the current reversal in the short-circuited coil is left, to overcome which either the brushes are given a lead or the machine is overcompensated. By using commutation poles, a magnetic field is obtained so as to produce in the coil undergoing short-circuit by the brush, an e.m.f. acting in opposition to its reactance voltage. The main drawbacks of machines fitted with commutation poles alone is that the main field is distorted by the armature reaction, so that the maximum voltage per segment is considerably increased on approaching full load, thus giving a greater tendency for "flashing over" with dust on the commutator. Absolutely sparkless commutation can be obtained from no-load to large overloads without any movement of the brushes. Such machines can be built about 10 to 15 per cent cheaper than those fitted with compensating windings, and for machines in which the maximum voltage per segment can be kept below about 30, and in some cases below 45, they are perfectly satisfactory. It is necessary that the iron of the commutation pole should be worked on the straight part of the *BH* curve, and consequently at a very low density, so that the reversing field increases in the same proportion as the armature current increases. In machines using both compensating windings and commutation poles, no distortion is given to the main field and a reversing field is obtained to overcome the e.m.f. in the coil undergoing short-circuit by the brush. Carbon seems to be the best material for the brushes.—Lond. *Elec.*, Feb. 21.

Induction-Motor-Generators.—An illustrated description of two induction-motor-generators for the London County Council tramways which are said to be the largest built in England. Each machine has an output of 1500 kilowatts at 500 to 550 volts at a speed of 135 r.p.m., and can carry 25 per cent overload continuously for one hour. The induction motors are of the wound-rotor type with slip rings for inserting the starting resistance, the stator being wound for the full normal pressure of 6600 volts between the three phases and a frequency of 25 cycles per second.—Lond. *Elec. Rev.*, Feb. 28.

Heating of Armatures.—G. SCHMALTZ.—An article illustrated by diagrams in which the author shows that it is incorrect to base the calculation of the conduction of heat in a laminated armature when magnetized on tests made in the unmagnetic condition. The reason is that the thermal conductivity of iron when being magnetized decreases in the direction of the flux. The author calculates the reduction of the thermal conductivity of the armature due to this cause and gives two numerical examples.—*Elek. Zeit.*, Feb. 27.

Commutation.—C. L. R. E. MANGES.—A letter in which the writer attacks the usual commutation theory and points out that several experimentally established facts cannot be explained on the basis of the old commutation theory.—Lond. *Elec.*, Feb. 21.

Carbon Brushes.—A long illustrated translation in abstract of the French article, noticed before in the Digest, on standardization tests with carbon brushes for dynamos and motors.—Lond. *Elec.*, Feb. 28.

Tests of Electric Machines.—F. LOPPE.—A long article giving general considerations on tests of electric machines and a comparison of the regulations of the American Institute of Electrical Engineers, the Association of German Electrical Engineers and the French Association of Steam Engine Owners.—*L'Ind. Elec.*, Feb. 25.

Lamps and Lighting.

Enclosed Flame-Arc Lamps.—In the Digest of March 14 the new Jandus "regenerative" enclosed flame-arc lamp was already noticed. Recent London journals now contain more detailed illustrated descriptions. If an ordinary flame-arc lamp would be enclosed, the fumes evolved from the chemically-impregnated carbons would soon form a deposit on the globe,

obscuring the arc. The new lamp has two special features. In the first place, special means are provided for obtaining a circulation of the gases past the arc, and, secondly, the light is mainly produced by raising certain gases to the temperature of incandescence, and not by the combustion of chemicals in the arc. The spectrum of the light from the arc is a band-and-line spectrum, showing that the gases are incandescing. Fig. 1

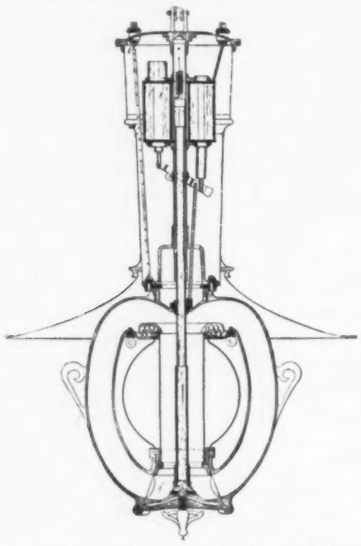


FIG. 1.—SECTIONAL ELEVATION OF LAMP.

shows the mechanism of the lamp, which is the same as is used in the ordinary Jandus single enclosed-arc lamp. The lower carbon, which is the positive, is held in a fixed support. Surrounding the arc is a clear glass cylinder, and outside this again is a translucent globe. The inner glass cylinder is in communication with two metal tubes, one on either side of the globe. There is a circulation of the hot gases up the central cylinder and down the other tubes, and the incandescent gases are carried round and subjected to the high temperature of the arc several times before finally condensing and settling in the outer tubes. The inner glass cylinder is kept perfectly clear of deposit for the greater part of its length, chiefly as a result of the high temperature which prevents the gases condensing, and also probably on account of the direct and strong draught past the arc. The upper negative carbon is an ordinary high-grade carbon. The lower carbon is also of high-grade carbon, but is star-shaped in section. The grooves between the eight rays of the star are filled with a chemical composition which is laid in in the form of a paste. The rods are then

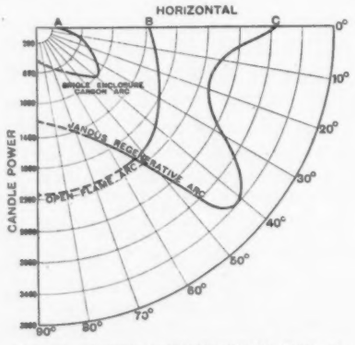


FIG. 2.—LIGHT DISTRIBUTION CURVES.

baked, and the paste expands into the pores of the carbon and fixes itself firmly into the grooves. The carbons themselves are not impregnated. About 15 grains of the composition are volatilized every hour, the gases rising up from the positive crater through the arc. The arrangement of the carbons and enclosed globes gives a favorable distribution of light, as can be seen from the curve of Fig. 2. The life of a single pair of carbons is over 70 hours. The light is of yellow-white color, but modifications can be obtained by varying the nature of the composition on the positive carbon. The 550-watt size taking 5.5 amperes at 100 volts, gives a mean hemispherical candle-power of 2200. This lamp is the invention of A. Denman Jones. The following comparative working costs of the new lamp and other works are given:

	Jandus regenerative flame lamp.	Inclined carbon flame lamp, metal cored carbons.	Multi-carbon or magazine flame lamps, cheap carbons.	Single enclosure pure carbon lamp.
Current	5.5 amps.	11 amps	9 amps.	5.5 amps.
Voltage	100 volts	50 volts	44 volts	100 volts
Watts	550	550	400	550
Mean hemispherical candle power	2,200	1,900	1,050	670
Life of carbons	70	10	40	80
List price of carbons per hour	0.32 cent	0.86 cent	0.56 cent	0.03 cent
Cost of current and carbons per 1,000 cp-hours at 4 cents per kw-hour	0.14 cent	1.60 cent	2.56 cent	3.32 cent

The lamp is mainly intended for street, open space and work-shop lighting.—Lond. *Elec. Eng'ing*, Feb. 27, and Lond. *Elec.*, Feb. 28.

Filament Support.—A note on a recent English patent of the British Thomson-Houston Company (Allgem. Elek. Ges.) for holders or supports for lamp filaments, incandescent at high temperatures, composed wholly of or having a surface coating only of pure thorium or magnesium oxide. The holder is molded, heated to a temperature of at least 2000 deg. C., and then dipped in a mixture of hydrofluoric and sulphuric acid. The melting point of the final product is very high, so that there should be no danger of the filament becoming fused to the holder.—Lond. *Elec. Eng'ing*, Feb. 27.

Train Lighting.—A long and fully illustrated description of the new train-lighting dynamo of the Felten & Guilleaume-Lahmeyer Company, which has already been noticed in the Digest.—Lond. *Elec. Rev.*, Feb. 21.

Power.

Electrically-Driven Rolling Mill.—An illustrated description of a new 15-in. Merchant rolling mill at a British steel works, driven by a 500-hp, three-phase motor. The motor runs at 245 to 250 r.p.m. Between the motor and the mill is a 28-ton fly-wheel, 19 ft. 6 in. in diameter. By means of a slip regulator the speed can be reduced momentarily to 110 r.p.m. if necessary, to allow the fly-wheel to give off extra energy to the mill during the short periods of very heavy load. The motor has a bar-wound rotor and current is supplied to the stator at 2000 volts. The windings of the rotor are connected to a liquid resistance, and this resistance is made to increase automatically as the load on the motor increases. The insertion of resistance in the rotor naturally causes it to lag behind the stator in phase, and, as the speed decreases, the fly-wheel supplies energy to the system. The same piece of apparatus includes both the starter and the regulator. The upper part of the vessel contains a number of horizontal pipes, through which water is circulated to keep the liquid cool, and below these are large horizontal plates which can be lowered into the liquid to decrease the resistance between them and fixed electrodes at the bottom of the tank. As the liquid is heated it rises and is cooled by the cold-water pipes, so that there is a continuous circulation. The moving plates are actuated by a hand-wheel, and are also independently attached to a lever carried on a projecting spindle by a small brake motor. The other end of this lever carries counterbalance weights. To start the mill motor, the plates are lowered by means of the hand-wheel after the main stator switch has been put on. After they have been lowered a certain distance, the lever engages with the lever attached to the brake motor. In the stator circuit of the rolling-mill motor there is a small three-phase series transformer, the secondary circuits of which are connected to the stator winding of the brake motor; the rotor of the brake motor is an ordinary short-circuited rotor. As the current supplied to the rolling-mill motor increases, the potential across the primary of this series transformer also increases, and the potential of the secondary rises sufficiently high to start the brake motor, the

speed of which will, of course, depend on the amount of extra load on the main motor. As the brake motor turns, it lifts the plates which are in the liquid and thus increases the resistance of the rotor carried in the main motor, and the speed of the main motor drops. When the load diminishes again, the brake motor no longer exerts sufficient torque to counterbalance the difference in weight between the moving plates and the counter-weights, and the former again fall, decreasing the resistance of the stator circuit in the main motor, and allowing it to speed up again, thus restoring to the fly-wheel the energy that it has given up to the mill during the heavy-load period.—Lond. *Elec. Eng'ing*, Feb. 27.

Austrian Transmission Plant.—A long and very fully illustrated description of the Lebring power plant in Steiermark, which transmits energy to Graz and the neighborhood. The plant was erected in 1903, and was the first one in Austria to employ a transmission voltage of 20,000. There are four turbines, each of 500 to 600 horse-power. The 430-kilovolt-ampere alternators generate current at 1500 volts, which is raised to 20,000 for transmission. There are 11 substations. The power plant, the transmission line and the substations are described in considerable detail.—*Elek. u. Masch.* (Vienna), Feb. 9, 16, 23.

Traction.

San Diego.—An illustrated description of the street railway system of San Diego, Cal., which is the furthest southwestern line in the United States, and the traffic of which has more than doubled during the last four years. The company has at present more than 35 miles of track. In the power house three turbo-generators, each of 500 kilowatts, have recently been installed.—*St. R'y Jour.*, March 14.

Electric Traction.—P. DAWSON.—A continuation of his long illustrated serial on electric traction on railways. In the present installment the author considers the suitability of the three-phase motor for electric traction, and discusses more particularly the Ganz system of control.—Lond. *Elec.*, Feb. 28.

Block Signals.—An illustrated description of the system of automatic block signals used on the Chicago South Side Elevated. The system as installed is a simple normal clear block signal system without distant protection or overlaps, but it differs in several respects from the methods used on other roads. The interval between trains has been reduced to one minute, or even less.—*St. R'y Jour.*, March 14.

Installations, Systems and Appliances.

Automatic Current Regulator.—An illustrated description of an electrolytic automatic regulator due to O. Sackur for obtaining constant current with varying voltage. It is shown in

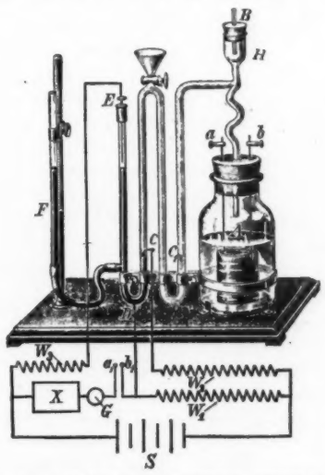


FIG. 3.—AUTOMATIC CURRENT REGULATOR.

Fig. 3. In the cell A water is decomposed between two large nickel electrodes, and the oxygen and hydrogen gas mixture escapes through the capillary tube B. Inside the cell A a pressure is produced which is proportional to the speed with which the gas escapes from B, and, therefore, also proportional to the current. The terminals a and b of cell A are connected with the terminals a_1 and b_1. In the sketch S is the source of current, K is the apparatus in which the current is to be kept constant, G an ammeter, and W_1, W_2 adjustable rheostats. By regulating W_1 the current through G and X is first adjusted to the desired value. Then the tube F is raised or lowered until the mercury is just below the platinum point C, but does not actually make contact with it. Further, the screw E is so adjusted that it is just above the mercury surface without actually making contact. If now the voltage of S should fall and the current in X and in the cell A will decrease, the gas pressure in A will decrease and the mercury in the monometer tube will rise and will make contact with C, so that the branch circuit $W_2 C D$ in parallel with W_1 is closed. The current through $A G X$ will, therefore, increase, contact C is broken, etc. On the other hand, if the e.m.f. should rise, the mercury will make contact with the screw E, and the branch circuit $D E W_2$ is closed, so that the current in $A G X$ decreases. Then the contact E is broken, etc.—*Electrochem. and Met. Ind.*, March.

Starter for Induction Motors.—An illustrated description of a starter for induction motors which is essentially a transformer in the main circuit to reduce the primary pressure for starting. The apparatus combines in itself starter, main switch and fuses. The transformer is of the autotransformer type, there being only one cell per phase, the reduced voltage being obtained by connecting the motor leads to intermediate points on the main coil. In the standard primary transformer starter three types are provided, thus giving three different transformation ratios.—Lond. *Elec. Rev.*, *Electrician*, *Elec. Eng.*, Feb. 14.

British Refuse-Destructor Power Station.—An illustrated description of the new municipal power station of Greenock, in which a refuse destructor has been included. There are two 750-kw generating sets and the main supply from the station is for power and lighting at 500 volts and 250 volts.—Lond. *Elec. Eng.*, Feb. 14.

Wires, Wiring and Conduits.

High-Voltage Fuses.—E. B. MERRIAM.—An illustrated article pointing out that recent developments on high-voltage fuses and tests on 60,000-volt transmission lines indicate that many desirable combinations of a non-automatic switch and fuses are possible, the switch serving to open or close the normal load of the line, and the fuses taking care of heavy overloads and short-circuits. This provides a very economical arrangement where there is a moderate amount of power to be tapped from a transmission line. To be satisfactory on high-voltage circuits a fuse must be quick-acting and it is now an established fact that a fuse blown in a confined space, such as a non-conducting tube of suitable dimensions, has the property of opening the circuit quickly, the arc being projected from both ends of the tube. This action can be improved if the tube is closed at one end and provided with a proper expansion chamber. A General Electric fuse of this type is described and illustrated.—*Gen. Elec. Rev.*, March.

Fuses.—W. FELLENBERG.—The conclusion of his illustrated paper on new enclosed high-tension fuses of the Allg. Elek. Ges.—*Elek. Zeit.*, Jan. 23.

High-Tension Insulators.—An illustrated article on high-tension insulators. While porcelain fulfils all the other requirements, it is opaque, so that it is impossible to detect by the eye a small fault within the mass. Glass is transparent, and any fault in it may be at once detected, but it is very fragile. While many engineers think that in the competition between porcelain and glass for high-tension insulators, glass is doomed, the author of this article thinks that this competition is not yet definitely settled. He describes some high-tension insulators of glass made by a French company, and gives also illustrated descriptions of several other high-tension insulators.—*L'Ind. Elec.*, Feb. 25.

Electrophysics and Magnetism.

Variation of Young's Modulus Under the Influence of the Electric Current.—H. WALKER.—A paper giving an account of an experimental investigation. The behavior of steel, soft

iron, copper, and platinum was examined when a current was passed through the wires. In the case of iron wire, the modulus in c.g.s. units at a room temperature of 20.4 deg. C. was 18.51×10^{11}; this fell to 17.30×10^{11} when the current had raised the temperature to 23.9 deg. C.; it then steadily increased to 20.19×10^{11} at a temperature of 50.6 deg. C., after which it decreased as the temperature was raised. In the case of steel, similar changes took place; the maximum value, however, was reached at 34 deg. After the temperature had been increased to 108 deg. it was reduced, and the maximum value of the modulus was then found at 57 deg. Copper behaved in exactly the same manner. Platinum behaved entirely differently, there being no initial fall in the modulus, which increased at a slower rate than in the above metals up to a temperature of 110 deg.—*Proc. Royal Soc. of Edinburgh,* for 1906-7, No. 4; Lond. *Elec.*, Feb. 21.

Magnetic Hysteresis in Rotating Fields.—T. Weiss and V. Planer.—According to Baily, there is no hysteresis in a rotating magnetic field, when that field is very strong. This important result has been confirmed in a more elaborate manner by the present authors. They used the method adopted by Blondel and Carpentier, but substituted for the permanent magnet an electromagnet, and operated upon a thin iron or nickel disk, suspended parallel or at right-angles to the axis of rotation of the field. Thus they were enabled to measure both the rotational and the alternating hysteresis. The hysteresis torque was found to be independent of the speed. The field was as intense as 10,000 gauss. In iron and nickel, the rotational hysteresis passes through a maximum and then decreases to zero as the field increased. At the maximum, the rotational hysteresis is just half the maximum alternating hysteresis. In feeble fields, on the other hand, the rotational surpasses the alternating hysteresis. It is not simply twice the latter, as alleged, but varies from four times down to zero. A field of 7300 gauss suffices to annul the rotational hysteresis in pyrrhotine. This field is also the "chief demagnetizing field."—From *Bulletin* 271 of the French Phys. Soc'y; abstracted in Lond. *Elec. Eng'ing,* Feb. 13.

Canal Rays.—An article on the Doppler principle and canal rays. From observations of Stark and others of the Doppler effect in canal rays it would seem that in this case the luminous particle which gives rise to the Doppler effect is not the molecule, but the atom at rest; that is, the atom deprived of its negative electron. While this would be very important, the question cannot yet be regarded as settled.—Lond. *Eng'ing,* Feb. 28.

Canal Rays.—E. Goldstein.—An English translation of a former German paper of the author in which he gives a condensed summary of many years' observations made by him since 1886 concerning canal rays, with additional notes.—*Phil. Mag.*, March.

Phosphorescence.—A. Stephenson.—The usual explanations of the phenomena of phosphorescence is that the energy communicated by the incident light is stored as potential energy of the molecules, and that on the removal of the light the change of configuration ceases to be stable and the system gradually returns to its initial state, the potential energy setting up vibratory motion and thereby becoming dissipated as emitted light. The author shows in this mathematical paper that a simple type of mechanical system exhibits the chief phenomena of phosphorescence, and, furthermore, that the agreement between the properties of the phosphorescing substances and those of his system is of a quantitative nature. From his point of view, energy stored by the system under the incident disturbance is kinetic.—*Phil. Mag.*, March.

Movement of Insulators in Magnetic Fields.—S. J. Barnett.—An abstract giving an account of an investigation of the electric displacement and intensities produced in insulators by their motion in a magnetic field, and its bearing on the question of the relative motion of ether and matter.—*Phys. Rev.*, February.

Mutual Inductance.—D. N. Mallik.—A highly mathematical paper giving formulas for the mutual inductance for the following cases: Two circular wires in any relative position to each other, carrying currents; mutual induction between two parallel rectangular wires symmetrically situated and carrying unit currents, and mutual inductance between two concentric and coplanar elliptic wires.—*Phil. Mag.*, March.

Units, Measurements and Instruments.

Measurements of Weak Alternating Currents.—H. Abraham.—For the measurement of weak alternating currents, such as telephone currents, and for the determination of the phase difference, a galvanometer with a moving coil and laminated electromagnet is specially useful since it allows great sensitiveness to be obtained, and this remains the same both in the measurement of continuous and alternating current of high frequency (500 and above). With an internal resistance of 100 ohms a thousandth of a milliampere can be detected. For the majority of applications, therefore, only a fraction of the working current need be used. The field of the electromagnet being $H \sin \omega t$, if a current $I \sin (\omega t - \phi)$ is passed through the moving coil, the permanent deflection will be proportional to $HI \cos \phi$. If this current is replaced by another with the same amplitude, but which is exactly in quadrature with the first, the deflection will be $HI \sin \phi$ and from these two readings the amplitude and phase of the current I can be found. A simple method of obtaining equal currents in quadrature is the following: Several turns of wire are wound on the electromagnet. The e.m.f. induced in this winding is in quadrature with the flux of the electromagnet. Or, a tapping is taking off to a non-inductive resistance connected in the exciting circuit of the electromagnet. The e.m.f. obtained is in phase with the flux in the magnet, and it is quite easy to make the second e.m.f. equal to the first. Concerning the application of this instrument to telephone lines, see abstract below.—Lond. *Elec.*, Feb. 28.

Maximum-Demand Indicator.—H. S. Hatfield.—An article on the Merz demand indicator which depends on the principle of allowing the motor meter, which is measuring the consumption on the installation, to turn for a certain definite period a counting train. At the end of this definite period the meter is disconnected from the gear through which the counting train has been turned, and the former is reset to its initial position. The meter is then reconnected, and the process repeated over again and again for the same time interval. The counting train acts as a non-return hand, and its indication shows the maximum consumption which has taken place during the resetting period. This principle has now been worked out and modified, and in the latest design the periods of resetting can be made anything from a quarter of an hour to two hours, according to the nature of the load, or by agreement with the consumer. The special feature of the new design is the use of an electrically-wound clock.—Lond. *Elec.*, Feb. 28.

Capacity of Paper Condensers and Telephone Cables.—A. Zeleny and A. P. Andrews.—A note on an American Physical Society paper. The free charge capacities of various condensers and of a telephone cable were compared with their capacities as obtained by the ordinary method where the galvanometer remains connected during the whole period of its throw. In most cases the free charge determinations can be made to within one-tenth of 1 per cent, and the capacities as obtained by the ordinary method are shown to be from 2 to 300 per cent greater than the free charge capacities, the amount of difference depending on the condenser. Errors are shown to exist in the present methods of determining the specific inductive capacities of dielectrics and in the resistance of dielectrics as obtained by the loss of charge method.—*Phys. Rev.*, February.

Current Balance.—W. E. Ayrton, T. Mather and F. E. Smith.—An illustrated Royal Society paper in which the authors describe a new "current weigher" specially designed and made by them for the absolute measurement of current. Very consistent results were obtained, and as the result of numerous determinations, the authors find the e.m.f. of the cadmium cell at 17 deg. C. to be 1.01871 volts, and that of the Clark cell to be 1.432, at 15 deg. C.—Lond. *Elec.*, Feb. 28.

Telegraphy, Telephony and Signals.

Propagation of Telephone Currents and Telephone Apparatus—H. ABRAHAM AND DEVEAUX-CHARBONNEL.—A full translation of their French paper, which has been noticed in the Digest, on the propagation of telephone currents through underground conductors. The authors experimented with frequencies from 250 to 500 on experimental lines of the type of the Paris underground network and found that the results experimentally obtained are in quite close agreement with the theory. In a second paper the authors discuss the most efficient working conditions for telephone apparatus. The chief requirements deduced by them are as follows: For all types of receiver where the inductance of the coils is given, the diameter of the wires should be such that resistance of each receiver is slightly more than a quarter of the apparent ohmic resistance R of the line, including the fine wire winding on the transformer. This rule necessitates the use of receivers whose resistance is between 100 and 200 ohms. If R is the apparent ohmic resistance of the line and M the internal resistance of the microphone, the most favorable value for the ratio of transformation is slightly greater than $\sqrt{R/2M}$, which works out between 6 and 7. To obtain the maximum efficiency, the impedance of the secondary winding should be considerably greater than the apparent resistance of the line. These three conditions seem to be fulfilled in all good commercial apparatus that the authors examined. The efficiency of the telephonic transformers was obtained by measuring the amplitude and phase of the currents and primary and secondary e.m.f. of the apparatus in circuit, and was found to be less than 60 in all the telephones examined. This low value seems to show that telephonic transformers are, in general, too small. Nothing is more easy than to obtain transformers whose efficiency is 90 per cent, and which correspondingly increase the transmitting power. Too much importance must not, however, be attributed to this improvement. Nearly half the energy is saved, but the ear is so little sensible to variations in the intensity of sounds that the hearing scarcely seems to be improved. To ensure a regular transmission to very great distances, inventors should concentrate their efforts on the microphone, for this apparatus is capable of great improvements.—Lond. *Elec.*, Feb. 28.

Factory.—Some illustrated notes on an English factory for making switches and rheostats.—Lond. *Elec. Rev.*, Feb. 28.

Labor Cost Distribution.—G. F. STRATTON.—An article describing the method of labor cost distribution which is employed at the shops of the General Electric Company.—*Eng'ing Mag.*, March.

Production System.—H. M. WHARTON.—An article on the organization of the "production system" of the Westinghouse Electric & Manufacturing Company.—*Eng'ing Mag.*, March.

Electric Signals.—An illustrated description of the system of electric signaling used in the Simplon Tunnel.—Lond. *Elec.*, Feb. 28.

BOOK REVIEWS.

GLEICHSTROMERZEUGER UND MOTOREN; IHRE WIRKUNGSWEISE, BERECHNUNG UND KONSTRUCTION. By W. Winkelmann. Hannover: Max Jaenecke. 124 pages; 40 illustrations. Price, 3.4 marks.

Although some little information is given concerning the performance of direct-current generators and motors, the major portion of this book is devoted to an outline of the methods of calculating the electric and magnetic circuits of these machines. The purely mechanical details have not been mentioned. A few suggestions are given with reference to commutation along familiar lines in accordance with practice which was considered standard five years ago, but the use of commutating poles is not discussed. The value of the book lies in the fact that the various formulas and design constants have been collected from the most reliable sources and are presented in convenient shape for immediate application.

MAGNÉTISME ET DE L'ELECTRICITÉ. By A. Nouguier. Paris: Librairie Polytechnique. 396 pages, 193 illustrations. Price, 12.5 francs.

This book aims to give an accurate theory of magnetism and electricity and the relation between the two. The author explains in detail those "laws" of electrophysics that are presented without explanation in elementary texts on physics, and are expressed in the form of mathematical equations in electrical engineering literature, such as the relation between the ampere turn and the flux produced thereby, cyclic variation in the permeability and the hysteresis loss which it causes, flux variation and its effect upon the time-phase relation of the current and the e.m.f. The treatment is that of a mathematical physicist and possesses little that will appeal directly to the practicing electrical engineer. At the same time, however, the presentation is characterized by clearness, and the book can be read with advantage by engineers who are not wholly adverse to the use of mathematics.

DIE GLEICHSTROMMASCHINE. By E. Arnold. Berlin: Julius Springer. 600 pages, 13 tables, 502 illustrations. Price, 20 marks.

This is the second volume of Professor Arnold's most excellent treatise on direct-current machinery. Volume I dealt with the theory and test, while Vol. II is devoted to the design, construction and operation of direct-current motors and generators. As may be judged from the number of pages and illustrations, the book contains a large amount of material; when it is known that there is no padding and that the descriptive matter relates to well-designed, modern machines, discussed by one who thoroughly understands the various design features, it will be appreciated that the book is of more than ordinary interest and value. After comparing the various insulating materials and the methods for applying the materials to the armature coils, the author describes the electrical and mechanical details of armatures, commutators, brushes, field coils and cores, and explains methods for testing the insulation of the machine and for insuring that the rotor is properly balanced. Dimensional drawings are given of 43 direct-current machines in rating from 2.6 horse-power to 1720 kilowatts. The latter machine is designed for 230 volts and provided with commutating poles and two commutators. Although the merits of the commutating-pole machine are not fully discussed, the method of calculating the proportions of such a machine is explained. The various special machines, such as constant-current generators, variable-speed generators, variable-voltage generators, three-wire generators and constant-current motors, are described. The book is not of a nature to render it well suited for the use of students. It can be accurately characterized as a most excellent reference book for designers of direct-current machinery.

EXPERIMENTAL ELECTRICAL ENGINEERING. By V. Karapetoff. New York: John Wiley & Sons. 790 pages, 538 illustrations. Price, $6, net.

This manual for electrical testing is characterized by thoroughness and completeness. There are 35 chapters, covering the whole series of tests conducted by junior and senior students in engineering laboratories. It differs somewhat from the usual laboratory manual in that considerable space is devoted to descriptions of the performance of various types of electrical machinery. The descriptive matter is presented in such a manner as to assist the student in understanding the phenomena in the machine being tested, and its presence allows him to perform the actual manual labor connected with the test in the most effective way; it does not relieve the student from the task of verifying the theory, but merely prevents him from wasting time in searching for things that are not to be found.

In addition to the usual tests of generators, motors and transformers, descriptions are given of tests of measuring instruments, transmission circuits, storage batteries, electric heaters and welders, arc and incandescent lamps. Great care has evidently been exercised in rendering the treatment accurate and in agreement with modern practice. It is to be regretted that,

after carefully distinguishing between power and energy, and the units watt and watt-hour, the author did not see fit to discard the term "wattmeter" when describing energy meters that are calibrated in watt-hours. Just why the manufacturers of electrical energy meters should assume that the word "integrating" when added to the word "wattmeter" introduces the idea of time the reviewer is unable to appreciate. What the instrument actually integrates is watt-hours and not watts. Undoubtedly the word "integrating" is properly used when applied to a type of photometer which indicates an addition of the light from a lamp in various directions. The text is largely free from the minor errors in expressions that convey the proper idea from the writer, while leaving the wrong impression upon the reader. However, the reviewer questions the advisability of attributing to "electric resonance" the compounding of synchronous converters by the use of inductive reactance in the supply circuits.

The material contained in the book has been well selected, logically arranged and presented in convenient form for laboratory use. The book is one that will be liked by both the student and the instructor.

Direct-Current Starting Rheostats.

The Westinghouse Electric & Manufacturing Company has developed a line of face-plate starting rheostats, which have

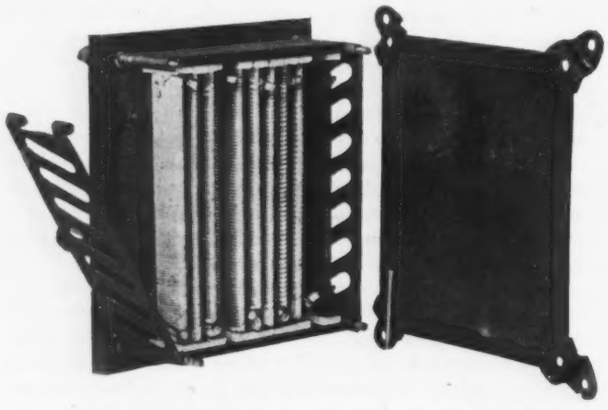


FIG. 1.—BAR-TYPE STARTING RESISTANCE OPEN FOR INSPECTION.

been designed to meet fully the specifications and conditions laid down by the National Board of Fire Underwriters and the American Institute of Electrical Engineers. The starters for

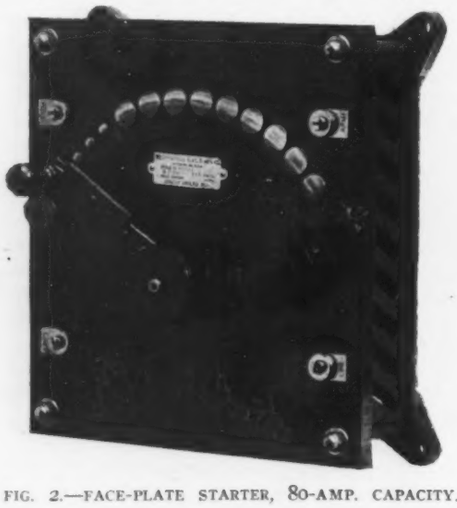


FIG. 2.—FACE-PLATE STARTER, 80-AMP. CAPACITY.

motors on 110 volts up to 22 horse-power, or 220 volts up to 35 horse-power, use the bar type of resistance, which consists of a resistance wire wound on iron bars which are first covered with a fireproof material. The ends of the bars are held in place by porcelain pieces, clearly shown in the illustrations. The construction is strong and rigid, so that adjacent turns on the same bar cannot short-circuit, nor can turns on one bar come in contact with turns on another bar. The whole construction, resistance, iron frame, slate front, contact arm, etc., is fireproof.

Another feature embodied in these starters is the low-voltage release. The contact arm will positively fly back to the off position if the current is shut off from the line, or if the volt-

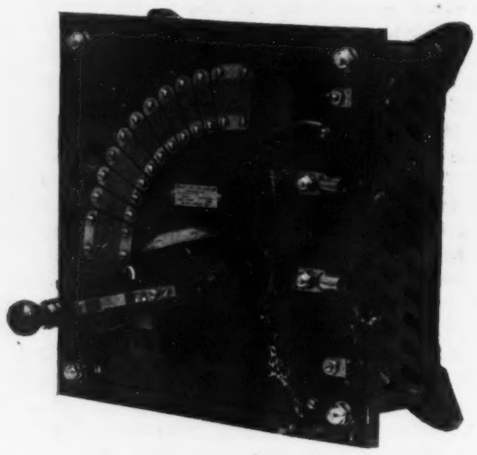


FIG. 3.—FACE-PLATE STARTER, 160-AMP. CAPACITY.

age falls below a fixed limit. This prevents damage to the motor should the current again be thrown on or the voltage rise suddenly to its full value. The method of connecting the magnet of the release coil is of special benefit where the field of the motor is to be regulated. The magnet is connected across the line independently of the shunt field and is unaffected by variations in the field current.

The small, button type of rheostat shown in the illustration is used on the smaller types of motors and is capable of carrying 80 amperes. For the larger motors, larger contacts are required; this requirement is met by furnishing renewable contacts, as shown in the illustration of the 160-amp. rheostat. In this larger type of starter a special short-circuiting brush is

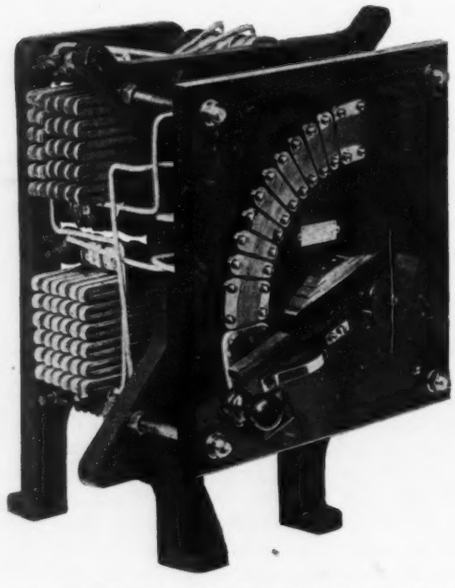


FIG. 4.—GRID-TYPE STARTER, 240-AMP. FACE-PLATE.

provided which cuts out the last contact, insuring the lowest resistance possible.

For starting motors on 110 volts of 25 horse-power, or 220 volts 45 horse-power and larger, the grid type of resistance is

used, which is fully ventilated and will stand the heavy duty required in starting large motors. All contacts, brushes, fingers and springs may be removed from the front with ease. This line of starters is adapted for 110-, 220- and 500-volt motors.

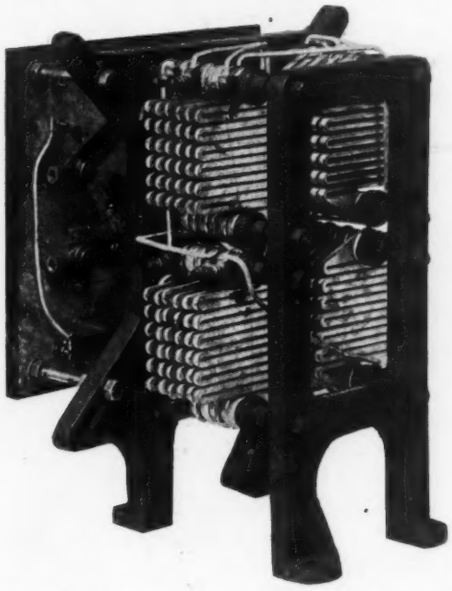


FIG. 5.—GRID-TYPE STARTER, 240-AMP. FACE PLATE, REAR VIEW.

As these rheostats are used only in starting, the handle will not remain on any point except the last, unless held. They are intended to bring the motor up to speed in 15 to 30 seconds, according to size, and are made for full-load conditions.

Universal Family Sewing Machine Motor.

To meet the demand for a sewing-machine motor that will reduce the selling effort upon the part of the dealer to the minimum and enable him to get prompt returns, the Westinghouse Electric & Manufacturing Company has placed upon the market a machine with all the necessary attachments for fitting any one of the standard types of sewing machines. This motor

FIG. 1.—MOTOR FITTED TO SEWING MACHINE.

is equally satisfactory on drop head and stationary head machines, and may be fitted to new or old machines. Full instructions for mounting and operating the motor are supplied to purchasers.

The motor is mounted on the top of the table and runs at a constant speed. The speed of the needle is regulated by increasing or decreasing the belt tension. A special brake and belt tightener arm is attached by chain to the foot pedal, which should be disconnected from the large balance wheel. Pressure on the pedal releases the brake, tightens the belt and starts the machine. Perfect regulation of the speed is obtained after a few minutes' practice. In fact the needle may be stopped with

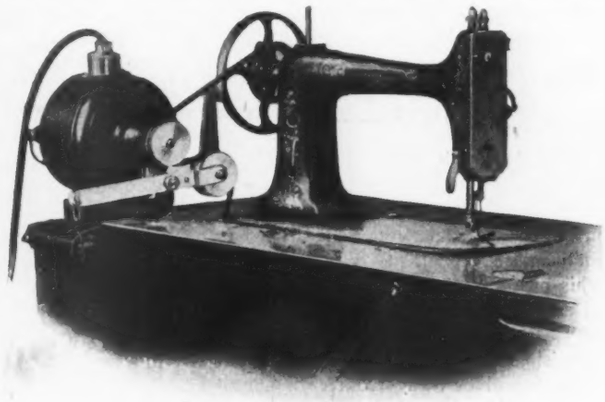


FIG. 2.—VIEW OF BRAKE AND BELT TIGHTENER.

greater promptness than when running from the foot pedal, and the usual control over the speed is readily learned.

The entire outfit presents a neat appearance, being well finished in black japan with nickel trimmings. The motor and its attachments are especially well made and will require a minimum of care and of attention in operation. These machines are made for 100-110 volt alternating-current, 60 cycles, and for 100-110 direct-current circuits.

Electric Glue Pot.

An electric glue pot recently placed on the market by the General Electric Company, embodies a new and interesting feature of design, namely, the elimination of the water jacket. The water jacket is a necessary feature of the ordinary glue put, inasmuch as this water serves not only to distribute the heat evenly to all parts of the glue, but also prevents it from becoming overheated. While necessary, it is also the cause of so much trouble as to render the ordinary and the earlier types of electric glue pots practically inoperative, when viewed from the standpoint of economy and satisfaction.

The elimination of the water jacket has been made possible by the adoption of a casting of pure aluminum which forms the glue pot proper. The high conductivity for heat, together with the proper design of the heating unit and proportioning of the radiating surface, combine to keep the glue at the proper temperature, although the maximum temperature of the ex-

ELECTRIC GLUE POT.

terior and bottom of the pot is said never to exceed 180 deg. Fahr.

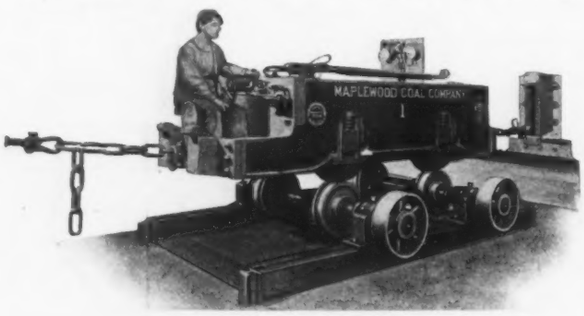
The heating element is of the well-known cartridge type, and possesses the characteristic features of simplicity, renewability and long life. It has been found that a saving in electricity has resulted by the omission of the water jacket, the energy

consumption of the smaller sizes being reduced as much as 50 per cent. The practical efficiency of the glue pot and the superiority for result-producing work claimed for it over the ordinary water jacket type, render it particularly valuable to carpenters, pattern makers, book-binders, etc. To the central-station manager it affords possibilities for building up a profitable day load and should prove as successful in this respect as the more popular electric flat-iron.

Electric Locomotive-Testing Plant in the Baldwin Locomotive Works.

In order to determine the actual performance of Baldwin-Westinghouse mine and industrial locomotives under service conditions before they leave the works, the Baldwin Locomotive Works have erected a testing plant similar to the locomotive testing plant that was used at the St. Louis Exposition. This plant, as shown in the accompanying illustration, consists of a pair of adjustable rolls upon which are placed wheels that may be moved to accommodate locomotives built for any gage. Provision for varying wheel base is made by movement of the rolls toward or away from each other.

The locomotive to be tested is anchored in position by



ELECTRIC LOCOMOTIVE TESTING PLANT.

chains attached to the ends. Suitable Prony brakes are used to measure the power developed by the motors, and a switchboard provided with the necessary electrical instruments enables a complete record to be made of the performance of every locomotive. Although a thorough test of the electrical equipment is always made before it leaves the Westinghouse works, at East Pittsburg, this test of the assembled locomotive is found to be of great advantage in that it insures the ability of the locomotive to operate continuously under service conditions.

Frink Adjustable Reflectors.

I. P. Frink, of 551 Pearl Street, New York, has brought out a line of adjustable reflectors especially suited for show-windows and other similar uses. These reflectors have been given the name of "Frinklet," and are made with a strong metal frame lined with the usual Frink special silver-plated corrugated glass in sections. The paneled end reflector is shown in Fig. 1. This is fitted with a nickel-plated twin socket for lamps of 8, 16 and 32 candle-power. With ordinary 16-cp lamps, the reflector is

FIG. 4.—FITTING FOR CONDUIT, CONDULET OR JUNCTION-BOX CONNECTION.

said to throw 125 candle-power on the floor of a window 10 ft. high. The twin socket, plain, open-end reflector is illustrated in Fig. 2, and the round reflector, which is 12 in. in diameter and is suitable for tungsten, tantalum and other high-efficiency lamps, is shown in Fig. 3. In all of the reflectors the silvering is protected against scratching by the metal covering, and the corrugated glass being inserted in sections, breakage due to expansion and contraction is eliminated, and any section broken by accident can be easily replaced. A feature of the "Frinklet" is the ease with which it can be adjusted to any size of window. By means of adjustable fittings, the reflector can be attached to the window frame or ceiling and be directly connected to molding, conduit or condulet so that no wires are exposed. The special adjustable fitting shown in Fig. 4 is intended for conduit, condulet or junction-box connection. The fitting shown in Fig. 5 is intended for molding connection and may also be used on window frames and ceilings with flexible cord feed. Fig. 6 illustrates an adjustable fitting for stems. The engravings show the fittings half size. It is evident that by means of the attachments shown the reflectors, with lamps, may be attached to any length of stem and used for ordinary illumination purposes or for illuminating paintings, statues, etc., the adjustable fitting making it possible to train the light at any desired angle.

FIG. 5.—FITTING FOR MOLDING CONNECTION.

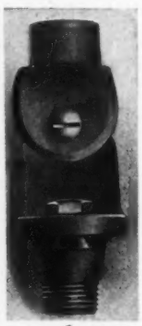


FIG. 6.—ADJUSTABLE FITTINGS FOR STEMS.

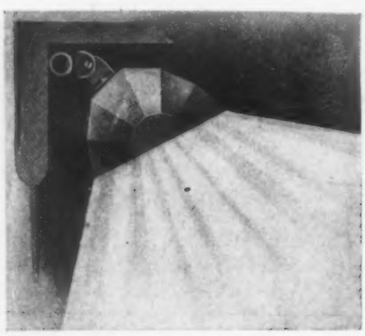


FIG. 1.—PANEL END REFLECTOR.

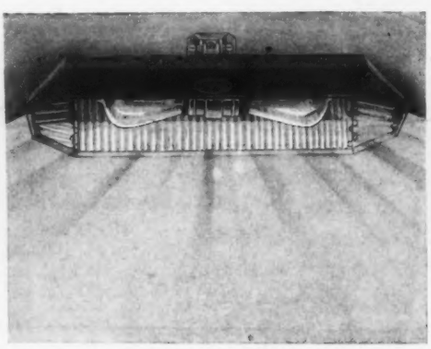


FIG. 2.—OPEN END REFLECTOR.

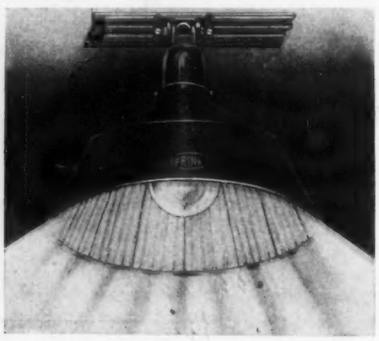


FIG. 3.—ROUND REFLECTOR.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Trade during the last week showed as much improvement as can be expected under existing conditions. Buying this year has been marked by extreme conservatism. The spring buying has passed its point of greatest activity, and although sales are much less than a year ago, as a whole the spring buying was much better than was anticipated several months ago. Industrial lines exhibit a great deal of irregularity. While steel and iron prices have been maintained pig iron shows weakness in spite of more inquiry. Coincident with the improvement in general conditions, the percentage of idle machinery decreases, but reductions in wages and dividends show that the forces of readjustment are still operating and will continue to operate for some time. Although dividends have shrunk, no general weakness has followed the decrease, the previous decline in prices offsetting the smaller returns on securities. No disturbances as yet have followed wage reductions and it is thought that the process of readjustment along this line will be completed without serious opposition on the part of employees. Railroad reports show that the number of idle cars has materially decreased. The winter wheat crop is in excellent condition and the prospects for spring farming are excellent. Money continues to grow easier gradually, and the reduction of the Bank of England rate to 3 per cent is the lowest point in rates touched by that institution since 1905. Many hopeful features developed in the electric field during the week, and in general the situation showed improvement over a week ago, both in increased orders and more inquiries. The General Electric Company received an order from the New York Central Railroad for 12 electric locomotives which will be of the "6000" type now in use. The bodies will be built by the American Locomotive Company. Another order received by the General Electric Company was for the electrical equipment of 125 cars for the Interborough Rapid Transit Company, and it reports a $1,000,000 order from the Chicago Railways Company, the largest electric order placed since the depression in October. It includes 400 four-motor car equipments. An order has been received by the General Electric Company for a complete substation equipment which will cost about $180,000, for the Companquia Pocas de Santos, Brazil, and smaller orders have been received from the Manchurian Railway, Corea, and the Sao Paulo Light & Power Company, of Brazil. As indicative of returning confidence, an order for 50,000 incandescent lamps for Rio Janeiro has been placed in New York. This is said to be the largest order for that class of electrical goods ever sent from South America.

MEXICAN TELEPHONE ENTERPRISE.—With the purpose of developing long-distance and wireless telephony between Mexico City and the port of Vera Cruz, a Mexican company with a capital of $500,000 is being formed. The organization of the company is being carried out by Francisco Alfaro, representing a group of London capitalists who are backing the enterprise. The concession for the establishment of long-distance, as well as wireless stations in the section of the Republic between Mexico City and Vera Cruz, was obtained by Manuel S. de Corbera and J. Sitzenstatter, an engineer, covers a period of 50 years, and allows the building of lines in and between various towns, such as Vera Cruz, Cordoba and Orizaba. Underground cables and lines will be laid in these towns. More than 5 kilometers of underground work has already been laid in Vera Cruz. The development of the wireless part of the concession will be left until a later time, the concessionnaires now devoting their attention to the stringing of wires between towns and the laying of underground cables in Vera Cruz. It is intended ultimately to spread a network of wires throughout the state of Vera Cruz, with the purpose of connecting it with the large rubber, coffee, sugar and other plantations. Governor Teodoro A. Dehesa and his secretary of state, Eliezer Espinosa, are greatly interested in the construction of adequate telephone service as planned by the concessionnaires, and General Porfirio Diaz, President of Mexico, it is reported, is assisting the enterprise with many suggestions.

STEAM TURBINE DEVELOPMENT.—As an evidence of the extent to which the steam turbine has been introduced as a power producer in large steam plants, the following data have been obtained from the Westinghouse Machine Company, of Pittsburg: The steam turbine business began in this country about 10 years ago. From that time until the close of the year 1907 the Westinghouse Company has manufactured and installed 493 machines distributed among 282 different plants, aggregating a total of 930,000 hp, or an average of 1886 hp per machine. But in addition to this output the shops at East Pittsburg had orders on hand at that time for 149 turbines, aggregating 323,000 hp more, so that up to the beginning of this year that company alone had taken orders for steam turbines aggregating a total of over 1,250,000 hp. When the steam turbine was first placed upon the market it was believed that its most fruitful field would be in the power houses of electric railway and lighting plants; it is interesting, therefore, to find that the company has installed turbines in 21 railroad power houses, 22 textile mills, 12 machinery power houses, 19 mining power houses and about 60 other manufacturing plants in the United States.

GENERAL ELECTRIC COMPANY OPERATING ON FULL TIME.—It is reported from Schenectady that 10,000 employees of the General Electric Company, who have been working four days a week for two months, will shortly go on full time as a result of large orders recently received by the company from the New York Central Railroad, the Chicago Railway Company and the Interborough Rapid Transit Company of New York. Other large orders for equipments in foreign countries have been received by the General Electric Company. It is stated that the volume of new business booked by the company at present is at the rate of $40,000,000 per annum, against a low point in December not exceeding $30,000,000 per annum. February was rather a poor month and did not show the comparative improvement over January's business which January showed over December. There is no question about the intention of the directors to pay the regular dividend of 8 per cent during the coming year.

THE ELECTRICAL JOBBERS' ASSOCIATION held a meeting at Niagara Falls March 17, 18 and 19, which was well attended by supply dealers from all parts of the country. Many representatives of the manufacturing interests were also present. The subject of most interest during the meeting was the reported intention of the Manhattan Electrical Supply Company to withdraw from the association. The Manhattan Company is about to open a large branch house on Forty-second Street, New York, where a full stock will be carried in addition to its present store at Park Place. It is understood that the same company may further extend its business by opening branches in other large cities throughout the country on the lines of its present Chicago store.

AMERICAN GOODS.—An American consul in Europe reports that a society recently organized in his district, whose members are expert technical men of all branches of trade, has opened a special bureau of information with a view to promoting the importation of goods of foreign manufacture. This bureau desires to be furnished with catalogues and price lists of all kinds of goods of foreign make so as to be able to put the local consumer in direct connection with manufacturers. Among the list of goods for which catalogues are requested are: motors, cables and electrical machinery. The name and address of the consul mentioned can be obtained by writing to the Bureau of Manufactures, Washington, D. C.

NEW PLANT FOR DUQUESNE LIGHT & ELECTRIC COMPANY.—It is reported that the Duquesne Light & Electric Company, of Duquesne, Pa., contemplates spending $4,500,000 in improvements, which will include a new central power plant. The company is capitalized at $500,000 and has authority to issue bonds to the extent of $10,000,000. Mr. George R. Webb, of Baltimore, was elected president of the company at a recent meeting of the directors, succeeding Mr. R. C. Hall, who becomes vice-president.

STATUS OF THE COPPER MARKET.—During the week the copper market showed considerable signs of strength. Domestic consumption since March 1 has undeniably increased. But local consumers have not rushed into the market, nor has the buying been in any considerable quantities. Genuine sales of several million pounds have been made, but they were strictly in accord with existing trade conditions and in line with the current policy of consumers to buy only such amounts as are required by immediate needs. The advance in price for Lake from 13c of a week ago to 13⅛c is to some extent justified by improved conditions among electric companies, notably the General Electric Company, which, it is announced, will operate shortly on full time, having received several large equipment orders. The Phelps Dodge Company, which in normal times is selling agent for 8,000,000 pounds of copper a month, is out of the market, it is reported, having sold ahead for the next two months. The wire companies which have been buyers of copper to some extent of late are expected to come into the market shortly for large blocks of the metal, and the brass companies, which report an increased demand for their goods, will be in the market within the next month on a larger scale. Although the rumors of large sales, ranging from 1,000,000 to 3,000,000-pound lots, are ridiculed by the trade, yet the dealers are optimistic over the outlook and 15c copper by the first of May is freely predicted. The London market is slowly responding to the improved tone in the American market. Stocks in the warehouses are being steadily reduced and the market rests on a good demand and supply basis. The exports from the port of New York since the first of March reached a total on Tuesday of 15,160 tons. The stock of Standard held in England is said now to consist practically of American electrolytic. American producers have shipped their accumulated supplies to foreign buyers, and with the sign of relaxation of pressure to sell, an improvement has set in both in America and Europe.

Prices on the Metal Exchange closed Monday as follows:

Lake	12⅞@13⅛c.
Electrolytic	12¾@13c.
Castings	12⅝@12⅞c.

The London market was as follows:

	Noon. £ s d	Close. £ s d
Standard copper, spot	59 5 0	59 10 0
Standard copper, futures	50 12 6	59 17 6
Market	Firm.	Firm.
Sales of spot		200 tons
Sales of futures		700 tons

Extreme fluctuations for the year:

	Highest.	Lowest.
Electrolytic copper, spot	13¾	12¼
Lake copper, spot	13⅞	12⅜
Casting copper, spot	13½	12⅛
London, spot	£64 5 0	£56 10 0
London, futures	64 10 0	61 17 6
London, best selected	67 10 0	61 0 0

The Utah Copper Company is now producing at the rate of 40,000,000 pounds of copper yearly, and it is expected that the production will be increased to 60,000,000 yearly. The last annual statement showed that the company was producing at a cost of below 8 cents a pound. The initial dividend will be declared in July of this year. The Consolidated Copper Company, organized a year ago by interests connected with the chief stockholders in the Cumberland-Ely, Nevada Consolidated and Utah Copper Company, is to have its capital increased from $50,000,000 as one of the preliminary steps to taking over the three properties mentioned. At the same time the name is to be changed to the Copper Mines Company. By August the Cumberland-Ely and the Nevada Consolidated will each be producing at the rate of 30,000,000 pounds of copper a year. All the properties of the Amalgamated Copper Company in Montana are again in operation, one of the Anaconda and one of the Parrot companies being the last to start up. The cost of copper production in Butte during the last few years has ranged from 9 to 12½ cents a pound, but this year it is considered certain that the cost will be kept much lower.

Financial Intelligence.

THE WEEK IN WALL STREET.—Early last week the reaction on the rising market which had been expected for several days took place and the market slumped, but at no time during the fluctuations which followed did it reach former low levels. The general improvement in trade conditions was reflected in the buoyancy of the market, which rose easily on occasions and at the close of the week was at practically its highest level and holding there strongly. The week was marked by a number of disturbing elements, among which was the reduction of the dividend rate from 6 to 5 per cent by the New York Central Railroad. A freer market for securities was indicated by the many announcements of new issues made during the week and in reflection of this condition the local banks once again added substantially to their reserves. The excellent report of the United States Steel Corporation for the previous year, with gross receipts of $757,000,000, or three-fourths of the entire amount of the original capitalization of the company, was one of the most encouraging features that has appeared for a long time. The report stated that orders received in January were 25 per cent better than orders booked in December, while February's orders exceeded those booked in January by about the same percentage, and the gain in March, up to the time of issuance of the report, over corresponding days in February, was at the same rate. On Monday of this week the market closed bullish with business on a broad scale. Stock prices ended not much below the highest of a session during which United States Steel issues, recognized leaders of the market, had reached the best figures of the year. Speculative sentiment was stimulated by a series of developments helpful to securities and the market closed strong and tending upward. Closing prices on Monday were as follows:

NEW YORK.

	Mar. 16.	Mar. 23.	Shares sold.		Mar. 16.	Mar. 23.	Shares sold.
All-Ch.	6⅜	7	2,800	Int.-Met., com..	7½	7¼	2,775
All-Ch. pfd....	17⅜	20½*	2,250	Int.-Met., pfd..	19¾	18¾	1,850
Amal. Cop.....	55¼	58½	257,170	Mackay Cos....	56½	55¾	500
Am. D. T.....	39*	39*	——	Mackay Cos. pfd.	62*	61*	——
Am. Loc.....	37	41½	9,910	Met. St. Ry...	16	17*	100
Am. Loc. pfd..	91½	92⅞	320	N. Y. & N.J. Tel.	98*	100	154
Am. Tel. & C'bl.	50*	50*	——	Steel, com.....	33	35	397,725
Am. T. & T....	108¼*	108⅜	800	Steel, pfd.....	97¼	98⅝	38,725
B. R. T.....	43¾	46⅝	114,410	W. U. T.....	49	49	1,320
Gen. Elec.....	120¼	123½	3,279	West'h, com...	40	40¼	725
Hud. R. Tel...	—	44*	——	West'h, pfd.....	59½*	40*	——

BOSTON.

	Mar. 16.	Mar. 23.	Shares sold.		Mar. 16.	Mar. 23.	Shares sold.
Am. Tel. & Tel.	109¾	108¾	——	Mass. E. R. pfd.	47½	45	——
Cumb'lnd Tel..	106¼	106½	——	Mex. Tel. pfd..	5	—	——
Edison El. Ill..	202	203	——	New Eng. Tel'p.	110	109	——
Gen. Elec.....	122½	123	——	W'st Tel & Tel..	7⅛	6¾	——
Mass. Elec. Ry..	10½	10	——	W. T. & T. pfd.	64½	62½	——

PHILADELPHIA.

	Mar. 16.	Mar. 23.	Shares sold.		Mar. 16.	Mar. 23.	Shares sold.
Am. Rys.....	42¾	42¾	——	Phila. Elec.....	7¾	7¾	——
Elec. Co. of Am.	9⅛	9	——	Phila. R. T....	16⅝	18⅝	——
Elec. Stor. B'ty.	28	26	——	Phila. Traction..	—	86	——
E. S. B'ty pfd.	—	—	——				

CHICAGO.

	Mar. 16.	Mar. 23.	Shares sold.		Mar. 16.	Mar. 23.	Shares sold.
Chicago City Ry.	150	155	——	Met. Elec. com.	17	17	——
Com.-Edison ...	90	91	——	National Carbon.	52	54	——
Chicago Subw'y.	—	—	——	Nat. Carbon pfd.	103	102	——
Chicago Tel. Co.	112	120⅛	——				

*Last price quoted.
Shares sold are for week March 16-21.

TRI-CITY RAILWAY & LIGHT COMPANY.—The regular quarterly dividend of 1½ per cent on the preferred stock, payable April 1 to stock of record March 27, has been declared by the directors of the Tri-City Railway & Light Company, of Davenport, Iowa.

HAVANA ELECTRIC REGULAR DIVIDEND.—The regular quarterly dividend of the Havana Electric Railway Company of 1½ per cent on the preferred stock, payable April 15, has been declared by the directors of the company.

HAVANA ELECTRIC REGULAR QUARTERLY DIVIDEND.—The directors of the Havana Electric Railway Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable April 15.

WASHINGTON WATER POWER COMPANY DIVIDEND.—The directors of the Washington Water Power Company, of Spokane, Wash., have declared the regular quarterly dividend of 1¾ per cent, payable April 1.

UNITED RAILWAYS OF ST. LOUIS DIVIDEND.—The regular quarterly dividend of 1¼ per cent on the preferred stock, payable April 10, has been declared by the directors of the United Railways of St. Louis.

NATIONAL CARBON REGULAR QUARTERLY DIVIDEND.—The directors of the National Carbon Company have declared the regular quarterly dividend of 1 per cent on the common stock, payable April 15.

MANCHESTER TRACTION REGULAR DIVIDEND.—The directors of the Manchester Traction Light & Power Company have declared a regular quarterly dividend of 2 per cent, payable April 15.

COLORADO TELEPHONE REGULAR DIVIDEND.—Directors of the Colorado Telephone Company have declared the regular quarterly dividend of 1¾ per cent, payable April 15.

NEW DIRECTORS FOR THE WESTINGHOUSE MACHINE COMPANY.—At a meeting of the directors of the Westinghouse Machine Company, held in Pittsburg on Wednesday, March 18, the number of directors was increased from five to nine, the last seven of the list which follows being the new directors. Those elected were: George Westinghouse, president; H. H. Westinghouse; James C. Chaplin, vice-president of the Colonial Trust Company, Pittsburg; William McConway, president of the McConway-Torley Company, Pittsburg; W. H. Donner, Pittsburg; Wilson A. Shaw, president of the Bank of Pittsburg; Robert Wardrop, president of the People's National Bank, Pittsburg; Horace E. Smith, of the Philadelphia banking firm of Chas. Smith & Sons, and John F. Wallace, of New York, formerly the head of the Panama Canal Commission. The retiring members of the board were George C. Smith, Walter C. Herr and E. E. Keller. Mr. H. H. Westinghouse stated, while in New York, that the machine company would be taken from the receivers' hands on April 1, that being the end of the company's fiscal year. Necessary steps to this end have been taken, there remaining only minor details, such as the accounting by the receivers, receivers' fees, etc. Speaking of business conditions, Mr. Westinghouse said: "The Electric & Manufacturing Company has fared much better during the recent stress than many other lines of business and electrical prospects are much brighter. But the railroads, the largest single field of commercial enterprise in the country, have been dealt a staggering blow. Railroad men view the outlook gloomily. None of them are going ahead with improvements as in past years, and even in the case of repairs the parts are being taken from idle equipment to supply the worn-out parts on active equipment, a condition of affairs almost unparalleled. It seems that there is not much chance for an immediate change, though I am an optimist and believe always in looking on the best side of things. Railroads have cut down their operating expenses to the minimum and I believe that in order to enable them to continue there must be some radical step taken, such as an advance in rates. The question of wage reduction has come up, but at best that is an unpopular move and one that railroad men dislike very much to take. An increase in rates would not arouse much opposition on the part of shippers, I believe, for they will see that it will help things along and they will be glad, moreover, to get business on which to pay the higher rates."

ILLINOIS TUNNEL AND CHICAGO SUBWAY MERGER.—It is reported that plans are completed for merging the capitalization of the Illinois Tunnel Company and the Chicago Subway Company. An official announcement of the plan is expected shortly. Already $30,000,000 capital stock of the tunnel company has been acquired by the Chicago Subway Company, which owns the stock of the Illinois Telephone Construction Company and the Chicago Warehouse & Terminal Company. There are $17,000,000 in 5 per cent bonds of the Illinois Tunnel Company outstanding, which are secured by a first mortgage on the property, bear 5 per cent interest and mature December, 1928. The plan proposes to take up these bonds, giving in exchange a 4 per cent collateral trust bond of the Chicago Subway Company. The basis of exchange, it is reported, will be 105 for the tunnel bonds and 85 for the subway bonds. The forthcoming issue of the latter is to be about $21,000,000, secured by a deposit of the tunnel bonds and stock and other valuable securities owned by the subway company. The assent of about 90 per cent of the tunnel holders of the bonds to the proposed change has been obtained, and those holders who do not wish to take any securities in exchange will have their bonds redeemed. E. H. Harriman and J. Ogden Armour are the controlling interests in the Chicago Subway Company, and have both been opposed to the plan of merger until the earnings of the subway company were enough to take care of the fixed charges on an issue of bonds such as is now proposed.

WESTINGHOUSE READJUSTMENT PLAN PROGRESSING.—Published reports which appeared in certain New York papers to the effect that the plan of reorganization for the Westinghouse Electric & Manufacturing Company was not progressing as favorably as was expected are emphatically denied by officers of the company, and the rumor that the plan might fail is declared to be entirely unfounded. The reports stated that the creditors of the company, who are scattered all over the country, have not responded in the manner expected and said that the matter of raising $7,000,000 working capital by the sale of an equal amount of assenting stock at par, or $50, was a matter of concern over which there were many misgivings. "There is no truth whatever in those statements," said one close in touch with the company's affairs; "such rumors are being constantly circulated among the newspapers by irresponsible persons and have absolutely no foundation in fact."

MARCONI COMPANY REPORT.—The annual report of the Marconi Wireless Telegraph Company, which will be mailed to the stockholders on March 30, will show a considerable improvement over the report of last year. The gross receipts received for messages sent during the year will be $8,250 more than for similar receipts in 1906-7, and profit and loss will also show an improvement for operations during the last 12 months. Gross profits will show an increase from $8,157.01 in 1906-7 to $13,822.55 in 1907-8, a gain of $5,665.54, or nearly 70 per cent. A saving of about $6,500 will be shown in administrative and general expenses, and a net decrease of more than $12,000. The report will call attention to a number of vessels equipped with the Marconi apparatus during the last year, and to the extension of the series of land stations which is planned. Certain valuable patents have been acquired and the rights to others are in the process of completion.

A $36,000,000 POWER CORPORATION FOR MACON, GA.—Announcement is made of the formation of the Central Georgia Power Company, a company capitalized at $36,000,000, which will develop the water powers of Middle Georgia. The new company, following conferences with the Governor and the Railroad Commission at Atlanta, was authorized by the latter to issue $20,000,000 in bonds and $16,000,000 in stock. At the conclusion of the conferences President W. J. Massee, of Macon, left for New York in company with James G. Campbell, partner in the banking house of A. B. Leach & Company, of New York, Boston and Chicago, which is said to have taken the bonds. Contracts will be entered at once for the expenditure of $25,000,000. The headquarters of the company will be at Macon.

ELECTRIC STORAGE BATTERY COMPANY REPORT.—For the fiscal year ended Dec. 31, 1907, the Electric Storage Battery reports gross earnings of $1,075,226, as compared with gross earnings of $1,331,799 for 1906, and a total net income of $821,274, as compared with $1,059,372 for the previous year. Dividends of $812,450 were declared, leaving a net surplus of $8,824, as compared with the net surplus for 1906 of $246,922. The total surplus was $3,669,327, a decrease of $85,124 from the previous year. Francis E. Bond, A. C. Humphries and William D. Winsor were elected directors to succeed Harry Payne Whitney, Thomas Dolan and H. H. Vreeland, who resigned. Otherwise no changes were made in the directorate.

CENTRAL UNION TELEPHONE COMPANY.—The Central Union Telephone Company, of Chicago, is negotiating for the control of the Indianapolis Independent Telephone Company. At present the Central Union Company has 400,000 stations in Illinois, Indiana and Ohio. Frederick P. Hanson and Ernest M. Kimball, of Chicago, have been elected directors.

PASADENA, CAL., MUNICIPAL BONDS.—The city of Pasadena, Cal., is inviting proposals for $100,000 in 4½ per cent municipal improvement bonds, part of the proceeds to be devoted to a municipal lighting plant. At an election held Feb. 20 the vote on such a plant was 1318 in favor and 454 against. Bids will be opened March 31.

AUTOMATIC TELEPHONE MERGER RUMORED.—Dispatches from Chicago state that Ogden Armour, of that city, is holding conferences with interests connected with the Chicago automatic telephone systems, with a view to combining the automatic telephone systems of the country.

AMERICAN CITIES RAILWAY & LIGHT DIVIDEND.—The directors of the American Cities Railway & Light Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable April 1.

ROCHESTER RAILWAY COMPANY.—The regular quarterly dividend of 1¼ per cent on the preferred stock has been declared by the directors of the Rochester Railway Company. The dividend will be payable April 1.

CINCINNATI STREET RAILWAY DIVIDEND.—The directors of the Cincinnati Street Railway Company have declared the regular quarterly dividend of 1½ per cent, payable April 1.

ELECTRIC BOAT REGULAR DIVIDEND.—The regular dividend of 2 per cent on the preferred stock, payable April 1, has been declared by the directors of the Electric Boat Co.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

RUSSELLVILLE, ALA.—The citizens are considering the question of establishing an electric light plant and water works system.

SLOCOMB, ALA.—We are informed that A. C. Kelley and M. E. Dougherty are interested in the construction of an electric light plant, the cost of which is estimated at $5,000, and for which bids are now being received.

EUREKA SPRINGS, ARK.—M. B. Baird, of Tulsa, Okla., has purchased the famous Blue Spring and properties surrounding the Walden Switch on the north side of the White River, and proposes to install an electric plant, which will secure its power from the source of the spring. The company will be known as the Eureka-Blue Spring Water Company and intends to establish a pleasure resort.

LODI, CAL.—An election will soon be held to vote on the proposition to issue bonds to establish water, light and sewer systems.

PASADENA, CAL.—The Pacific Electric Railway has decided to double-track all of its lines in Pasadena. H. E. Huntington is president of the company.

REDDING, CAL.—Harry L. Shannon, of San Francisco, has appropriated 2000 cu. in. of water of the Bear Creek, 15 miles southeast of Redding, the water to be diverted through a canal to a power house, where electricity will be generated. Mr. Shannon was the organizer of the Northern California Power Company, and also of the Shasta Power Company. He is not now connected with either company, but states that he will soon have another company in the field.

RIVERSIDE, CAL.—Plans are being made by the Riverside & Arlington Railway Company to build a new electric railway to Crestmore, where the large cement works of the Southern California Cement Company are in course of construction. Right of way for the railway has already been secured.

SANTA ANA, CAL.—A proposition recently submitted by N. A. Ulm to build an electric railway from Tustin through this city across the Santa Ana River to Huntington Beach has been endorsed by the Merchants and Manufacturers' Association. A committee has been appointed to secure subscriptions to the stock. The road will be built by local capital and will be operated independently. The cost of the road is estimated at $150,000.

WOODLAND, CAL.—The Pacific States Telephone Company is reported to be contemplating extensive improvements in its service in central and northern California, principally on the west side of the river.

NEW HAVEN, CONN.—The United Illuminating Company is preparing to install turbines at its power plant between the Mill River bridges in Grand Avenue.

WESTPORT, CONN.—The Westport Electric Company has made arrangements to extend its transmission lines on Compo Street to the Beach and expects to be able to furnish electricity for lamps by May 1.

SMYRNA, DEL.—The Diamond State Rapid Transit Company, recently incorporated for the purpose of constructing an electric railway from Delaware City to Lewes, is making arrangements to commence the construction of the road. The railway will be 98 miles in length. The power station will be located at St. Georges. John D. Thompson, of Wilmington, architect, has been engaged to prepare plans for the power house. It is expected that construction will commence within 60 days. J. W. Endean is general manager.

WILMINGTON, DEL.—A syndicate, with a capital stock of $1,000,000, has been formed to construct an electric railway from Lewes to Rehoboth, and Ocean City, Md. The promoters are said to be Philadelphia and Wilmington men.

WASHINGTON, D. C.—Bids will be received at the Government Printing Office, Washington, D. C., until April 15 for furnishing electrical supplies, etc., during the fiscal year ending June, 1909. Blank proposal forms and other information may be obtained by addressing the above office. Henry T. Brain, acting Public Printer.

WASHINGTON, D. C.—Bids will be received until March 31, at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yard, New Orleans, La., a portable electric grinder, as per schedule 907. Applications for proposals should designate the schedule desired by number. E. B. Rogers is paymaster-general.

WASHINGTON, D. C.—Bids will be received until April 15 at the Department of the Interior, Washington, D. C., for furnishing electrical supplies, etc., during the fiscal year ending June 30, 1909. Forms of proposals, etc., will be furnished on application; requests for blanks must designate the classes of supplies upon which it is proposed to bid. James Rudolph Garfield is secretary.

WASHINGTON, D. C.—Bids will be received at the office of the Secretary of Department of Agriculture, Washington, D. C., until April 15 for furnishing electrical supplies, etc., during the fiscal year ending June 30, 1909. Full information will be furnished on application to the disbursing clerk. James Wilson is secretary.

WASHINGTON, D. C.—The Senate has passed the bill authorizing the construction of a dam and bridge across the Missouri River near Great Falls. The bill as passed confers authority on the Secretary of War to permit the Missouri River Improvement Company of Montana to construct a dam across the Missouri River, with canal and appurtenances for water-power and other purposes.

MACON, GA.—The Central Georgia Power Company has received permission from the State Railroad Commission to issue $16,000,000 in capital stock and $20,000,000 in bonds. The company is planning to develop various water power properties on the Oconee, Ocmulgee and Flint rivers owned by the company. The first plant will be erected on the Ocmulgee River, eight miles from Jackson, which is capable of developing 18,000 horse power, the cost of which, including the entire equipment and transmission lines, is estimated at $1,850,000. Lockwood, Greene & Company, of Boston, Mass., have charge of the construction of the plant. Contracts will soon be awarded for the work. W. J. Massee, of Macon, is president of the company.

MADISON, GA.—The new municipal electric light plant has been completed and was put into operation March 10.

HAILEY, IDAHO.—Arrangements are being made to operate the Crœsus mine and new mill by electricity. The Cramer Electric Company will furnish electrical energy and is now extending its transmission line to the mine.

PARIS, IDAHO.—Extensive improvements are contemplated by the Bear Lake Electric Light & Power Company to its plant, which will involve an expenditure of about $12,000. The company contemplates putting in a pipe line from the spring, which forms the head waters of Paris Creek, to the site of the present power house, and the erection of a new power house. The plant will have an output of about 1000 hp, which will be sufficient to light the whole valley and to operate an electric railway from Montpelier to the lake.

CHICAGO, ILL.—The Chicago City Railway Company has purchased a site at Brighton Park on which it proposes to erect a power station and car barns.

CHICAGO, ILL.—Work will commence on April 1 by the Chicago & Northwestern Railway Company and the Chicago, Burlington & Quincy Railroad Company on the installation of the electrical equipment for the Wood Street freight yards, which will involve an expenditure of $2,000,000.

DECATUR, ILL.—The City Council has granted a franchise to the Decatur, Sullivan & Mattoon Interurban Railroad Company. The company has secured the entire right of way, and it is expected that work on the construction of the road will begin soon. The power plant will be located in Decatur. R. B. Starbuck, of Mattoon, is president of the company.

GALATIA, ILL.—The Galatia Independent Telephone Company has increased its capital stock from $1,056 to $2,480.

LEMONT, ILL.—The Village Board is considering the question of installing electrical apparatus in the pumping station to replace the present steam plant. The contract for street lighting does not expire for another year. It is expected that provision will be made for an all-night service and additional lamps.

MATTOON, ILL.—The Mattoon-Hillsboro Interurban Railroad Company has secured all of the right of way for its interurban line with the exception of Mattoon. It is expected that the franchise will be acted on favorably soon. The power plant will be located in Mattoon. W. R. Patton, of Charleston, is president of the company.

NOBLESVILLE, IND.—We are informed that the Noblesville Heat, Light & Power Company has extended its transmission line to Federal Hill, a suburb of Noblesville, and has also taken a contract to supply electricity for lamps and motors in Cicero, and is planning to extend its transmission lines to other near-by towns. C. E. Layton is manager.

PLYMOUTH, IND.—The capital stock of the Winona Telephone Company has been increased to $100,000, and arrangements made to complete 10 farmers' lines, several of which were commenced last fall, but owing to the early winter were not completed.

UNIONDALE, IND.—The directors of the rural telephone lines of Uniondale and Poe have decided to unite and construct a commercial line from Poe to Ossian, thereby extending the services of both companies. The officers of the Uniondale line were elected as follows: Frank Hoopengardner, manager, and Wells Newhard, secretary and treasurer.

ATLANTIC, IA.—The Atlantic Gas & Fuel Company, which has recently been organized under a new management, proposes to furnish electricity and gas for lighting.

CLEAR LAKE, IA.—The local telephone company is contemplating a number of changes and improvements to its system, including the installation of a new switchboard, new cables and extension of lines.

DAVENPORT, IA.—The Independent Light & Power Company has given to the German Trust Company a trust deed covering all its property rights, franchises, etc., to secure an issue of $600,000 in bonds.

TOPEKA, KAN.—William C. Stewart, superintendent of the municipal electric light plant at St. Joseph, Mo., has been engaged to investigate the Topeka municipal electric light plant and street lighting system to make an estimate of the cost of rebuilding and extension of the municipal electric lighting system, with a view of asking for a vote April 7 on the proposition of issuing bonds to enlarge the same.

LOUISVILLE, KY.—The Board of Aldermen has passed an ordinance granting a franchise to the George G. Fetter Company, which will enable the company to sell electricity within a limited district in the city, for which he is to pay the city $5,000.

NEW ORLEANS, LA.—The City Council has granted to D. O. Hewitt, of McCook, a 20-year franchise to construct and operate an electric light and power plant. A. R. Scott, of McCook, is consulting engineer.

SHREVEPORT, LA.—The City Council has passed an ordinance granting a franchise to John Lorenz to construct and operate an electric railway in this city.

SANFORD, MAINE.—The citizens have voted to accept the proposal of the Sanford Light & Power Company to enter into a contract for street lighting for a period of 10 years. Under the terms of the contract the company is to furnish incandescent street lamps at $10 per lamp per year, which is $2 less than the town is paying under the present contract.

ANNAPOLIS, MD.—The Maryland Senate has passed the bill incorporating the Wicomico Electric & Power Company.

CLINTON, MASS.—The committee of the Board of Trade appointed last summer to investigate the matter of procuring for Clinton the electricity to be generated at the Wachusett dam by the Metropolitan Water and Sewerage Board, has submitted its report, in which it states that electrical energy to the amount of 2500 hp hours for 3000 hours per year will be generated at the dam, which the Metropolitan Water and Sewerage Board is willing to dispose of at $15 per horse power under certain conditions. The committee recommends that steps be taken toward making a contract with the board for the entire amount, to be bought in bulk and distributed to the smaller industries.

HOLYOKE, MASS.—Proposals will be received until March 28 by W. H. Snow, manager of the Gas and Electric Department, for enlarging and altering the municipal electric light station of the city of Holyoke, plans and specifications for which can be obtained from the superintendent of the station.

PETERBORO, MASS.—The citizens have voted to appropriate $3,800 for repairs and improvements to the municipal electric light plant; also to extend the commercial and street lighting service in the town, providing those desiring commercial lighting will pay for the wiring from the present terminus at the Carter corner to their residences.

SALEM, MASS.—The County Commissioners are planning to construct a new boiler house at the county jail, and when completed it is probable that an electric lighting plant will be installed to furnish electricity for lamps for the county buildings.

SOUTH FRAMINGHAM, MASS.—At the annual town meeting the citizens voted to award the contract for street lighting to the Edison Electric Lighting Company for a term of one year and to increase the appropriation to $9,000 for a one-year contract. The company submitted the same proposal as in previous years, offering a 5 per cent reduction on a five-year contract, with provision that the town may revoke the contract at any time on 90 days' notice if it should decide to enter into municipal lighting, and to change the street lamps from 32 to 40 cp.

WAKEFIELD, MASS.—The question of abandoning the municipal lighting plant and purchasing electricity and gas for the town from some private corporation, or the expenditure of $72,000 to put the plant in first-class condition, is being seriously considered by the town. It is claimed that the plant has been run at a loss for the last few years. A committee of nine has been appointed to investigate the matter and was also authorized to secure the services of an expert at a cost not to exceed $800, and to report not later than the November town meeting. The estimated cost of putting the electrical branch of the plant in up-to-date condition is $52,000, and an expenditure of $20,000 will be required for the gas plant.

WEST MEDWAY, MASS.—A proposition has been submitted by the Edison Electric Illuminating Company to furnish the town with electricity for street lamps at a reduced rate for a long period. If a contract is made for 10 years a discount of 10 per cent will be given, which will make the rate $15 per lamp per year, or a discount of 20 per cent for a 20-year contract, making the price for each lamp $12 per year.

ANN ARBOR, MICH.—The new power plant of the Washtenaw Power Company at Lowell has been completed. The plant is equipped with all the appliances for the thorough scientific testing of the flow of water and securing data concerning turbine power under all conditions. The plant is to be placed at the disposal of the engineering department of the university as an experimental station for the use of the students in that department.

HASTINGS, MICH.—Bids will be received by the Thornapple Gas & Electric Company for the construction of its proposed substation.

MENOMINEE, MICH.—The Menominee Light & Traction Company is planning to develop the water-power of the Menominee River at Chappee Rapids, four miles from this city, and will erect a large power plant at that place at a cost of $400,000. The company will transmit electricity to Menominee and Marinette, Wis., for lamps and motors. The interurban railway between Menominee and Escanaba will be built as soon as the right of way can be secured.

UTICA, MICH.—The capital stock of the Utica Electric & Water Company has been increased from $22,000 to $30,000.

WAYNE, MICH.—The Village Council has entered into a contract with the Washtenaw Light & Power Company to furnish electricity to light the streets of the village. The company is to install a plant and have it in operation by Oct. 1. The streets are now lighted by an acetylene gas plant, owned by the village, which will be abandoned.

BEMIDJI, MINN.—The Beltrami Electric Light & Power Company has resumed work on its dam at the rapids in the Mississippi River. The plant will be in operation in August.

CROOKSTON, MINN.—Arrangements are being made to build a co-operative farmers' telephone line, with 40 miles of pole line between Haug and Greenbush and Badger.

LAKE CRYSTAL, MINN.—The property of the Lake Crystal Milling Company, which includes the city electric light plant, was sold at auction March 12 to C. S. Christenson, of Madelia, for $12,500.

MINNEAPOLIS, MINN.—An ordinance granting a franchise to the Northern Heating & Electric Company has been introduced in the City Council. Thomas McDermott, of St. Paul, is attorney for the company.

MINNEAPOLIS, MINN.—H. L. Burdick, superintendent of the Rocky Mountain Bell Telephone Company, has announced that an eastern extension of the lines through Montana has been planned for this year.

THIEF RIVER FALLS, MINN.—The Thief River Falls Electric Railway Company has decided to purchase a site for a dam at some point along the Red Lake River. It is proposed to develop the water power to furnish electricity to operate the proposed electric road.

GULFPORT, MISS.—Plans are being made by the Gulfport & Mississippi Traction Company to increase the output of its power plant by 1500 kilowatts. The new equipment will include the installation of a turbo-generator set. The cost of the improvements is estimated at $120,000.

HATTIESBURG, MISS.—Arrangements have been made by the Hattiesburg Traction Company for the sale of $300,000 in bonds, the proceeds of which will be used for the erection of a new electric light and power plant, and the completion and equipment of the street railway system, for which seven miles of track have already been laid. Work on the construction of the power plant will begin early in April, and it is expected to have the street railway system in operation during the summer.

AURORA, MO.—The Cassville & Western Railroad has been purchased by a syndicate of Eureka Springs, Ark., capitalists. The road will be equipped to be operated by electricity and will be extended to Roaring River.

KANSAS CITY, MO.—J. C. Herring, chief engineer of the Kansas City & Southeastern Railroad Company, writes that surveys have been completed and the right of way secured for a railway, about 30 miles in length, which will extend from Kansas City through various towns. The present plans contemplate operating the line with gasoline electric cars. An issue of $600,000 in bonds will be floated to build the road. The officers of the company are: Charles A. S. Sims, president; H. W. Gibson, vice-president; B. F. Shouse, treasurer, and George P. Norton, general attorney, all of Kansas City, Mo.

OMAHA, NEB.—It is reported that the owners of the Boyd Opera House have decided to install a private lighting plant.

HENNIKER, N. H.—The citizens have voted to extend the electric lighting service to the Wilkins Mill.

NEW MARKET, N. H.—At a town meeting held recently the citizens voted to postpone indefinitely the proposition to install a municipal electric light plant. The Selectmen were authorized to enter into a contract with the New Market Electric Light, Power & Heat Company to furnish electricity to light the street and public buildings for a term of five years at a cost of $2,000 per year. In case they cannot make a contract at the above price, they are authorized to make a contract for one year at $2,400, the price paid last year.

ROCHESTER, N. H.—The local telephone exchange was destroyed by fire recently, entailing a loss of about $15,000.

RUMNEY, N. H.—Arrangements are being made to organize a stock company for the purpose of establishing an electric light plant in the town. The citizens have voted to enter into a contract with the company, should it become incorporated, to light the streets of the town at a cost of $500 per year, using 65 incandescent lamps.

TILTON, N. H.—The Town Board is considering the question of securing an improved electric lighting service.

EGG HARBOR CITY, N. J.—Steps are being taken by the Egg Harbor City Telephone Company to construct a telephone line from Green Bank to Lowe Bank.

MORRISTOWN, N. J.—The Morris County Traction Company is making plans to resume work on the construction of its railway between Union and Elizabeth.

PATERSON, N. J.—Announcement has been made by Thomas N. McCarter, president of the Public Service Corporation, that the cost of lighting for the County of Passaic would be reduced from $140 to $100 per lamp per year. Although the present contract will not expire for three and one-half years, the change in price will go into effect immediately. The county will also be able to light the county thoroughfares and bridges within the city limits at the same rate as paid by the city, which is $78 per lamp per year, making a saving of $62 on each lamp.

VINCENTOWN, N. J.—Plans are being made by the citizens of this town to incorporate a telephone company to construct a telephone line from Vincentown to Tabernacle.

VINELAND, N. J.—The Governor has signed the bill appropriating $20,000 for a new lighting and heating plant for the Vineland Soldiers' Home.

MELROSE, N. M.—Contracts have been let by the Roosevelt County Telephone Company for the construction of an extension to its toll line west of Melrose, which will be 40 miles in length; also for the construction of an exchange building for both the toll and local systems, to replace the building which was recently destroyed by fire.

ARCADE, N. Y.—The citizens on March 17 voted to establish a municipal electric light plant to cost $35,000.

BROOKLYN, N. Y.—Extensive improvements are being made by the Coney Island & Brooklyn Railroad Company, which include the installation of a high-tension transmission system, the replacing much of the rolling stock and the overhauling of its roadbed. The cost of the work is estimated at $1,500,000. S. W. Huff is president of the company.

EAST WORCESTER, N. Y.—The Public Service Commission, second district, has granted the petition of the Great Bear Light & Power Company to construct its plant and exercise its franchises within the villages of Worcester, West Richmondville and Richmondville; also for permission to issue $20,000 in capital stock, a first mortgage for $20,000, and $20,000 in bonds to be secured by said mortgage.

NEW YORK, N. Y.—Bids will be received by the Board of Health, Department of Health, corner of Fifty-fifth Street and Sixth Avenue, Borough of Manhattan, until April 1, for furnishing materials and installing electric and gas lighting fixtures in the Measles Pavilion of the Kingston Avenue Hospital, Kingston Avenue and Fenimore Street, Borough of Brooklyn. Thomas Darlington, M. D., is president of Board of Health.

NEW YORK, N. Y.—Bids will be received until March 30 by C. B. J. Snyder, superintendent school buildings, for electrical equipment for public schools as follows: No. 153, Borough of Manhattan; No. 17, Borough of Brooklyn; No. 90, Borough of Queens.

RANDOLPH, N. Y.—The plant and holdings of the East Randolph Telephone Company, with exchanges at Randolph, Conewango, Steamburg and Kennedy, has been purchased by John H. Wright, of Jamestown. The company has a capital stock of $10,000, with a bond issue of $10,000.

GREENSBORO, N. C.—The new Proximity mill now under construction will be operated by electricity generated at the power plant of the White Oak Mill, the equipment of which is now being increased by the installation of two additional steam engines of the Corliss type of 2000 hp each, direct connected to two 1500-kw generators.

SILER CITY, N. C.—Arrangements are being made by the Matthews Telephone Company for the construction of a telephone line from this place to Ramseur.

BRYAN, OHIO.—The City Council has passed an ordinance providing for an issue of $10,000 in bonds for improving the electric light and water plant.

MONTPELIER, OHIO.—The citizens have voted to issue $30,000 in bonds for rebuilding the municipal electric light plant and water works system.

NORWALK, OHIO.—The capital stock of the Local Telephone Company has been increased from $400,000 to $600,000, the proceeds to be used for improving and developing the system and to take care of its rapidly increasing business.

WEST TOLEDO, OHIO.—A bill has been presented in the State Legislature to authorize townships trustees to make contracts for lighting the streets of unincorporated villages upon petition of the owners of the majority of the foot frontage of the streets to be lighted. The bill is general, but was drafted upon request of West Toledo citizens.

YOUNGSTOWN, OHIO.—Preparations are being made by the Central Union Telephone Company for the construction of an underground conduit system.

CLINTON, OKLA.—The Clinton Light & Power Company is reported to have closed a contract for the construction of a power house.

ALBANY, ORE.—Announcement has been made that the present horse-car street railway will be equipped to be operated by electricity at once and will be in operation within 60 days. The Willamette Valley Company will supply electricity for the system. Additional machinery will be installed in the plant, which has already arrived. J. E. Ross is local manager of the railway system.

KLAMATH FALLS, ORE.—Application has been made to the City Council by W. H. Mason, representing the Inland Electric Company, for a franchise to construct and operate an electric railway from the eastern limits of the city to the terminus of the line of the Klamath Falls Land & Transportation Company. The Inland Electric Company proposes to construct and operate an electric railway between Klamath Falls and Merrill, a distance of 25 miles.

GLENDALE, ORE.—The officers of the local telephone company have decided to extend a rural telephone line from this city to Fernvale.

MEDFORD, ORE.—Plans are being made by the Oregon Rapid Transit Company for the construction of a network of electric railways to cover the Rogue River Valley from Grant's Pass to Ashland. The company has located water rights for the development of 30,000 horse-power, but is now negotiating with the Condor Water & Power Company for electrical energy. The officers of the company are: F. C. Page, president; S. E. Nye, secretary; F. E. Herrick, treasurer, and F. L. Evans, general manager.

PORTLAND, ORE.—The City Council has granted a franchise to the United Railways Company for the construction of its lines to Mount Calvary Cemetery and Hillsboro.

HANOVER, PA.—Plans have been completed for the extension of the Hanover Street Railway to Littlestown, by the way of McSherrystown, a distance of seven miles. The contract for the work has been awarded to John Dobbling, of York. Another extension five miles in length is contemplated from McSherrystown to New Oxford. The projected line will then be extended to Berlin Junction, where the East Berlin Branch Railway, a steam railway, will be equipped to be operated by electricity, and the road continued through Abbottstown to East Berlin. When the railway is completed to Littlestown it is proposed to extend the electric railway to Gettysburg, 10 miles distant.

JOHNSTOWN, PA.—The application of the Johnstown Passenger Railway Company for permission to extend its railway system from East Conemaugh to the substation now under construction for the company, a distance of four and one-half miles, has been approved by Governor Stuart.

LANCASTER, PA.—The application of the Rohrerstown, Landisville & Mount Joy Railway Company for permission to extend its railway system in the town of Mount Joy has been approved by Governor Stuart.

MONONGAHELA, PA.—The Monongahela & Carroll Street Railway Company has been granted a franchise over Park Avenue to the city limits by the City Council. George Hosack is president of the company.

SHAMOKIN, PA.—Plans are being made by the Shamokin-Mt. Carmel Transit Company to enlarge its power station and install a 750-hp Corliss-Cooper engine and a 500-kw General Electric generator.

WAYNESBORO, PA.—The Chambersburg, Greencastle & Waynesboro Street Railway Company has awarded contracts for the erection of the transmission line between Greencastle and Chambersburg, and for the substation at Marion to J. G. Schaff Electrical Company, of Chambersburg, and the Westinghouse Electric & Manufacturing Company. Additional machinery for the power house will be purchased in the near future.

YORK, PA.—Surveys are being made for the proposed York, Glen Rock & Shrewsbury Electric Railway. S. M. Manifold is engineer for the company.

INTERIOR, S. D.—Arrangements are being made by the Interior Telephone Company for the extension of its lines from Interior to Rapid City, and from Chamberlain into Pukwana, and from there to Brule. J. W. Sanford is president of the company.

MILLINGTON, TENN.—The electric light plant and water works system have been purchased by J. W. Page, of this place.

PIOCHE, NEV.—A local telephone system will soon be established in the place.

BROWNSVILLE, TEX.—A street railway franchise has been granted by the City Council to John G. Fernandez, A. C. Brokaw, F. W. Kidde and others of Brownsville.

CHILDRESS, TEX.—The City Council closed a contract for a 24-hour electric light system, which is to be in operation by June 1. The Council has also granted a franchise for an electric street railway system, two miles of which is to be in operation within the next year.

ELSINORE, UTAH.—The citizens are considering the question of installing an electric light plant in this place. It is proposed to install a dynamo and other necessary machinery in the Elsinore Mill to generate electricity by water power from the river at that point. J. M. Parry, Joseph Bland and others are interested in the project.

LOGAN, UTAH.—The High Creek Electric Light & Power Company is installing an additional 350-kw generator and 500-hp turbine to the present equipment of its plant. The company now furnishes electricity for lamps and motors in Smithfield, Richmond, Lewiston and Trenton, Utah, and Franklin and Preston, Idaho. J. I. Shepard, of Richmond, is general manager.

SALT LAKE CITY, UTAH.—The contract for the erection of the transmission line of the Strawberry Valley irrigation project has been awarded to Henry Gardiner, of Spanish Fork, Utah. This transmission line will be about 30 miles in length and will extend from the power plant of the U. S. Reclamation Service, near the mouth of the Spanish Fork Canyon, to the west portal of the Strawberry tunnel, where the electrical power will be used for the completion of the tunnel.

CHRISTIANSBURG, VA.—The Montgomery Electrical Company, recently incorporated, has been organized and the following officers elected: J. L. Vaughn, of Roanoke, president; E. S. Hagan, vice-president; T. W. Simpson, chief engineer, and E. J. Jones, consulting engineer. The company has acquired the property of the Greyson Electric Company and the municipal plant at Christiansburg.

ROANOKE, VA.—Bids will be received until March 31 by W. E. Thomas, city clerk, for lighting the streets, alleys and public parks of the city with 250 or more electric arc lamps for a term of five years from Nov. 1, 1908, until Nov. 1, 1913. Bids will also be received for furnishing electrical energy for 250 or more are lamps; also for constructing and equipping an overhead lighting system to be owned by the city, consisting of all the necessary fixtures, wires, poles, lamps, etc. W. B. Bates is city engineer.

CHEHALIS, WASH.—Application has been made to the City Council by Eugene A. Marsh, representing the Seattle Electric Company and the Northwestern Long-Distance Telephone Company, for a franchise for the construction of an electric railway, light and power plant and telephone and telegraph system in Chehalis and Centralia.

ROSALIA, WASH.—Extensive improvements are contemplated for the town, including the installation of an electric lighting and water works system. The Inland Empire Electric Railroad Company has a franchise for an electric lighting system, and promises to have the system in operation by July.

MEDICAL LAKE, WASH.—The Washington Water Power Company has commenced work on the erection of its transmission line from this place into the Big Bend country. The company will furnish electricity for lamps and motors in Reardan, Davenport, Harrington, Sprague and other places.

NORTH YAKIMA, WASH.—Plans are being made by the Northwest Light & Power Company to extend its transmission lines to Wapato and Toppenish. It is stated that the line will cost about $1,600 per mile, but if enough business can be secured to pay the interest on the investment the extension will be made. It is also planned to erect substations in the towns.

APPLETON, WIS.—The Fox River Valley Telephone & Telegraph Company is installing a new switchboard in the local exchange and also in its exchange in Wrightstown. The company will also build exchanges in Kaukauna, Neenah and Menasha.

JUNEAU, WIS.—Plans are being prepared by W. G. Kirchoffer, Madison, Wis., for a two-story power house for the city.

KEWAUNEE, WIS.—At an election to be held May 18 the citizens will vote on the proposition to issue $20,000 for an electric light plant.

MILWAUKEE, WIS.—An estimate of the cost of a municipal electric light plant prepared by R. W. Hunt & Company, of Chicago, Ill., has been submitted to the Common Council. Estimates were made upon the basis of 2000 and 3000 arc lamps, with one extra unit for commercial purposes in each instance. Separate reports were also given for plants run by gas and by steam. A plant operated by gas with an output for 3000 lamps will cost $1,245,449, while for 2000 arc lamps the plant would cost $920,000. A steam plant for 2000 arc lamps will cost $823,492, and for 3000 lamps $1,079,607. The above estimates were furnished to the Board of Public Works in compliance with a resolution adopted by the Common Council in February for the purpose of letting the people know the cost of the plant when they vote on the question of municipal lighting at the April election.

MONROE, WIS.—The Monroe Electric Light & Power Company has submitted a proposition to the City Council for a renewal of the street lighting contract, whereby the company agrees to install new magnetic lamps at the same price that is now paid by the city for the lamps now in use, which is $65 per month, and if the city decides to change the schedule from 12:30 o'clock until 1 o'clock the cost will be $69 per month. The contract is to be for a term of 10 years.

MUSCODA, WIS.—The Village Council has awarded the contract for the construction of the dam at Balmoral, about three miles north of the village, to Salmon & Rasqua, for $2,850. The dam, which furnishes power for operating the municipal electric light plant, was washed out about six weeks ago, leaving the village in darkness. The cost of the work when completed will cost about $15,000.

CHEYENNE, WYO.—Bids will be received until April 15 at the office of the constructing quartermaster, Cheyenne, Wyo., for steam heating, plumbing, electric wiring and furnishing and installing electric light fixtures in the various buildings at Fort D. A. Russell. Specifications and blank form of proposal may be obtained at this office. Plans and specifications for the work specified above, for the inspection of bidders, will be placed as follows: In office of depot quartermaster, Omaha, Neb.; chief quartermaster, Chicago, Ill.; depot quartermaster, St. Louis, Mo.; depot quartermaster, New York, N. Y.; chief quartermaster, Denver, Col. Captain V. K. Hart, acting quartermaster, U. S. Army, has charge of construction.

SHERIDAN, WYO.—It is reported that S. A. Broadwell, representing Eastern capitalists, is negotiating with the City Council for an electric railway franchise. It is proposed to connect the large coal camps with the city.

EDMONTON, ALB., CAN.—Plans have been prepared by City Engineer Keeley for the proposed electric light plant, the cost of which is estimated at $149,000.

LADYSMITH, B. C., CAN.—Mayor Nicholson has promised the Citizens' League that he will endeavor to arrange for the construction of a civic electric lighting plant.

REGINA, SASK., CAN.—W. W. Hilton, architect, has a proposal for the development of electrical power at the Government dam now being constructed.

MISSION, B. C., CAN.—J. Wintemute, of this town, has been granted permission to use 300 cu. in. of water from Silver Creek, and proposes to install an electric plant to furnish electricity for this town.

NEW WESTMINSTER, B. C., CAN.—S. S. McDiarmid, of Vancouver, representing the Sunset Power Company, has made application for 15,000 cu. in. of water from the Quanli River.

PHOENIX, B. C., CAN.—The Granby Consolidated Copper Company is making arrangements to improve and enlarge its smelting works near Grand Forks. Orders have been placed for machinery and additional electrical equipment, which will increase the output of the smelters to 4500 tons per day. An engine of 500 horse-power will be installed. The converter plant will be enlarged, and the new converters will be operated by electricity. Two new blowers will be operated by four 150-hp electric motors. The cost of the improvements is estimated at $200,000. A. B. W. Hodges is local manager.

CRYSTAL CITY, MAN., CAN.—At the annual meeting of the Louise Telephone Company it was decided to endeavor to purchase all the government telephone lines within the municipality of Minto. For further information address W. J. Mutch, Crystal City, Man.

RUSSELL, MAN., CAN.—The United Telephone Company has been formed, with a capital of $20,000, to take over the business of the Russell Telephone Company. It will build a number of extensions and generally improve the system. Goodbun Brothers, of Russell, are managers.

WINNIPEG, MAN., CAN.—The City Council has decided to proceed with the water-power development at Point du Bois Falls as soon as possible and the Board of Control has taken steps toward the construction of the tramway from Lac du Bonnet to Pointe du Bois.

WINNIPEG, MAN., CAN.—A by-law is now in preparation ordering all the wires of the Winnipeg Electric Company underground. F. E. Cambridge is city electrician.

WINNIPEG, MAN., CAN.—The Municipal Power League has presented a petition to the City Council which calls for the immediate construction of the civic power plant at Lac du Bonnet at an estimated cost of $3,250,000. Cecil B. Smith is consulting engineer.

NEW SARUM, ONT., CAN.—A new telephone company has been organized with the following directors: G. L. Sommers, David Caughell, W. Rockie, Bruce Griffin, L. R. Cloes, S. Penhale. David Caughell is chairman and B. Griffin secretary.

OTTAWA, ONT., CAN.—A bill is before Parliament giving entire control of telegraph and telephone systems in the Dominion to the Railroad Commission. The commission will have power to fix rates and enforce the carrying out of agreements between companies and municipalities or individuals.

PORT ARTHUR, ONT., CAN.—An agreement has been reached regarding the purchase of the portion of the municipal street railway system which runs in Fort William. The price will be agreed upon by arbitration, but in the meantime this city will continue to run the system as before by supplying electrical energy, etc. An agreement is now being drawn up which provides that the city of Port Arthur is to supply the electrical energy unless it can be obtained cheaper elsewhere. Address Mayor Carrick, of Port Arthur, or Mayor Murphy, of Fort William.

ST. CATHERINE'S, ONT., CAN.—The city has granted an extension of time till Aug. 1 next to the Falls Power Company for supplying electricity to the city. The price to be paid is $39.50 per arc lamp per year. J. Albert Pay is Mayor.

TORONTO, ONT., CAN.—The city has stopped all negotiations with the Toronto Electric Light Company and will make application at once to the Hydro-Electric Power Commission for a supply of electrical energy to the amount of 7500 kw.

WELLAND, ONT., CAN.—It is reported that the British Canadian Smelters, Ltd., are preparing to erect a large plant on the Niagara River, in the township of Willoughby, and are now negotiating with the Hydro-Electric Power Company for electrical energy to operate the plant.

GANANOQUE, QUE., CAN.—A by-law providing $10,000 for the completion of the electric lighting plant was passed by the ratepayers. Address R. H. Williams.

MOOSEJAW, SASK., CAN.—J. D. Murphy is authority for the information that the Saskatchewan Telephone Company will build a long-distance line from Estevan to the Manitoba boundary, having recently completed the system between Moosejaw and Estevan.

MOOSEJAW, SASK., CAN.—Sealed tenders will be received by John D. Simpson, secretary and treasurer, until April 6 for the following machinery and equipment in connection with the municipal electrical plant: One turbo-alternator and exciters; condensers and pipework; main switchboard and connections. Plans and specifications will be sent upon application and deposit of $25, which will be refunded on receipt of a bona fide tender.

PRINCE ALBERT, SASK., CAN.—Estimates for the cost of developing the water power of the Saskatchewan River at Steep Creek for the city have been prepared by Charles H. Mitchell, Toronto. He reports that 10,000 hp can be developed at an approximate cost of $350,000 and 100,000 hp for $1,000,000. It is stated that the city has decided to erect a plant on the river. C. O. Davidson is city clerk.

New Industrial Companies.

THE HEAT, LIGHT & REFRIGERATOR COMPANY, of Portland, Me., has been incorporated, with a capital stock of $5,000,000. H. P. Sweetser is president and L. L. Hight, of Portland, Me., treasurer.

THE RADIO BATTERY COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $100,000. The incorporators are Roland B. Respess, Harry L. Robinson and John W. Kinne, of New York. The company proposes to manufacture and install storage batteries, etc.

THE CUMMINGS PATENT FURNACE CONSTRUCTION COMPANY, of Jersey City, N. J., has filed articles of incorporation, with a capital stock of $150,000. The incorporators are H. O. Coughlan, L. H. Gunther and J. R. Turner, of Jersey City. The objects of the company are to manufacture boilers, furnaces, fire boxes, etc.; also to carry on a business of mechanical and electrical engineering.

THE KENT MILL COMPANY, of Jersey City, N. J., has been incorporated, with a capital stock of $2,000, by Frank H. Hall, Charles D. Thompson and David Edwards. The purpose of the company is to deal in electrical appliances.

THE JOVE MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $5,000, to manufacture mechanical and electrical apparatus. The incorporators are Perry Saylor, C. R. Forster, Allan H. Pratt.

THE SWITCHBOARD SECURITIES CORPORATION, of Wilmington, Del., has been incorporated, with a capital stock of $1,000,000, by T. Conyngton, Upper Montclair, N. J.; O. Jacobs, of Riverhead, N. Y., and P. L. Garrett, of Hockessin, Del.

Personal.

MR. ALEX. HENDERSON, who has been away from New York for some six months, and has visited a large part of the South and West in that period, besides making a trip to the Sandwich Islands, has just returned, and is in his old familiar haunts at the Engineers' Club, much to the pleasure of a host of friends. He is very sanguine as to the general electrical outlook.

MR. CLARENCE E. DELAFIELD has resigned as the head of the high-tension division of the Ohio Brass Company and has accepted a position as sales manager for the Ideal Electric & Manufacturing Company, of Mansfield, Ohio. For many years Mr. Delafield was connected with the Wagner Electric Company as its St. Louis district manager, and hence is familiar with the commercial side of the industry.

MR. DUDLEY D. PENDLETON, who for 15 years has been connected with the Westinghouse Companies, has resigned from that organization and will go in business for himself in Pittsburg as a consulting and contracting engineer. For the last four years Mr. Pendleton has been handling a large part of the Westinghouse steam railroad work in the East, and previous to that time had managed numerous important operations in western Pennsylvania, and is probably one of the best-known electrical men in that section of the country. Besides engineering, he has had a broad experience in the mining field.

MR. F. W. SANFORD and Mr. S. O. Ochs, both formerly connected with the Stanley Instrument Company, of Great Barrington, Mass., expect to sail on March 28 for Russia. They go in the interest of prominent American manufacturers for whom they will establish Russian agencies. Mr. Ochs, who was more recently associated with the Boston office of the Fort Wayne Company, has had wide experience in Russian business methods, and this, combined with his knowledge of the languages, will afford these gentlemen exceptional opportunities to carry through their enterprise. Their address in Russia will be in care of the Gebhard & Hoy Company, Ltd., Moscow, Russia.

MR. LESTER G. FRENCH has been engaged by the American Society of Mechanical Engineers to direct its editorial department. Among the immediate improvements to be undertaken is the establishing of departments in the monthly *Proceedings*, thus providing a greater variety of technical articles of interest. Mr. French received his degree in mechanical engineering from the Massachusetts Institute of Technology in 1891. After four years' apprenticeship, drafing room and shop experience, and a year and a half as a text book writer, Mr. French was engaged on the editorial staff of *Machinery*, and for nine years was editor-in-chief. Recently Mr. French re-engaged in the publishing of text books on algebra, applied mechanics and of a treatise on steam turbines.

Unclassified Items.

HILTON, N. Y.—The citizens have voted to issue $5,000 in bonds to establish a lighting plant.

HOLLAND, MICH.—Plans are being contemplated for extensions to the municipal electric light plant, which will double the output of the plant. It is expected that the work will be taken up this year.

LIBERTY, IND.—The Board of Trustees are considering the question of granting a franchise to Clinton Egbert and Paul C. Morey, of Hamilton, Ohio, for the installation of an electric light plant in the town. The streets of the town are now lighted with gas.

HARTLEY, IA.—The citizens have voted in favor of issuing $12,000 in bonds for an electric light plant.

BUCYRUS, OHIO.—It is reported that the proposition to issue $90,000 in bonds for a municipal electric light plant will be submitted to a vote of the people.

PROVIDENCE, R. I.—A bill to incorporate the Blackstone Valley Gas & Electric Company has been introduced in the House of Representatives by W. D. Bullock, of Pawtucket. The measure allows the incorporators to acquire and dispose of the rights and franchises and property of gas and electric companies in Providence County and to deal in the stocks and securities and calls for a capitalization of $3,000,000. The act is practically for the purpose of allowing the Pawtucket and Woonsocket companies to consolidate or merge. The incorporators are John A. Arnold, Charles E. Ballou, George Barchelor, Stedman Butterick, Jonathan Chace, Frank A. Sayles, Charles A. Stone, Edwin W. Webster and others. The above companies are now controlled by the Stone & Webster interests, of Boston, Mass.

BARNESVILLE, GA.—An election will soon be held to vote on the proposition to issue $25,000 in bonds for constructing an electric light plant, water works, etc. T. W. Cockran is Mayor.

EDINBURG, VA.—Bids will be received until April 11 for an electric light franchise. J. D. Lennon is Mayor.

MINNEAPOLIS, MINN.—All bids received March 16 for furnishing a lighting plant at the county farm were rejected. Hugh R. Scott is county auditor.

HIGGINSVILLE, MO.—The light and power plant of the Higginsville Milling Company was destroyed by fire recently, entailing a loss of about $4,000.

ATCHISON, KAN.—The Atchison Railway, Light & Power Company contemplate rebuilding its plant during the coming season, which will involve an expenditure of between $60,000 and $80,000.

AINSWORTH, NEB.—The Ainsworth Electric Lighting Company is planning to start work on the construction of its dam, and expects to have its plant in operation by next October.

DALLAS, TEX.—The citizens will vote April 7 on the proposition to issue $50,000 in bonds to install a municipal electric light plant.

COLUMBUS, OHIO.—The municipal ownership bill, introduced by Senator Howe, of Cleveland, provides that cities shall have the right to purchase electric light and water plants now owned by private companies and bonds may be issued to pay for such properties, but whenever the amount issued for this purpose exceeds one per cent of the total value of the property in such corporation listed for taxation, then the issue must first be authorized by a vote of the people in the village or city.

SEDAN, KAN.—N. B. Wall has purchased an electric generator, which will be installed in his plant for the purpose of furnishing electricity for lamps and fans in this town.

DOWNS, KAN.—A company of local capitalists, including H. H. Welty, F. M. Wells, Harrison Brothers and others, have purchased the electric light plant here, owned by B. M. Stephenson, for $15,000. A company will be incorporated with a capital stock of $25,000. It is said that the new owners contemplate making improvements to the plant.

BLUFF CITY, TENN.—Matthew Miller, of Bristol, recently purchased the electric light plant and water power of the Holston Electric Company of this city.

AMITE CITY, LA.—J. M. Ritson, of New Orleans, has assumed charge of the electric lighting system here and will give the plant a thorough overhauling. Several thousand dollars will be expended in making improvements.

LOGAN, UTAH.—At the annual meeting of the High Creek Electric Light & Power Company the following-named officers were elected: David Eccles, of Ogden, president; Joseph Monson, of Logan, vice-president; Joseph Quincy, of Logan, secretary; D. C. Budge, of Logan, treasurer, and J. I. Shepard, of Richmond, general manager.

COLUMBUS, OHIO.—At the annual meeting of the Columbus, Delaware & Marion Railway Company the following-named officers were elected: John G. Webb, president; O. M. Gottschall, vice-president; H. B. Hane, secretary; N. J. Catrew, treasurer, and George W. Whysall, general manager.

MILFORD, N. J.—At the annual meeting of the Delaware Telephone Company the following-named officers were elected: Alton C. Rapp, president; Mahlon W. Angell, vice-president; William H. Farrand, secretary, and Elmer E. Culver, treasurer.

CHARLESTON, S. C.—At the annual meeting of the Charleston Consolidated Railway, Gas & Electric Company the following-named officers were elected: Philip H. Gadsden, president; Samuel H. Wilson, managing director, and P. J. Balaguer, secretary.

FREDERICKSBURG, VA.—At the annual meeting of the Fredericksburg Power Company the following-named officers were elected: William C. Whitner, president; A. P. Rowe, vice-president, and A. T. Embrey, secretary and treasurer. The company will resume in the spring the work of the development which was suspended for the winter.

MR. P. H. ALEXANDER.—A very large circle of friends and acquaintances will regret deeply to learn the news of the death of Mr. P. H. Alexander, at South Nyack, N. Y., last week. The funeral took place on Monday. Mr. Alexander had had a long connection with electrical development. He was at first associated with the old Thomson-Houston Company, and then joined the Westinghouse forces, becoming general manager of the old Sawyer-Man Company. He then went into the electrical supply business, founding the firm of Alexander, Barney & Chapin. In more recent years he was connected with the Southern Electric Company, with headquarters at Baltimore, and was engaged in development work in the South. So wide an area of contact had made him extensively known throughout the field, and his death at the age of 60 removes one who was very prominent in the early, exciting times of electric light introduction and growth in this country. The cause of death was diabetes, complicated with grippe.

Business Notes.

MR. E. J. COYLE has resigned as manager of the Southern Electric Company, of Baltimore, and associated himself with the Baltimore Electrical Supply Company as sales manager.

THE LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, has moved into its newly erected factory at Kelley Avenue and Thirty-eighth Street. The floor space available in the new plant is three times greater than that of the former location.

MR. F. M. SHEPARD has taken charge of the Philadelphia office of the Northern Electrical Manufacturing Company, Land Title Building. Mr. Shepard has been in the sales department of the company at Madison for several years and renews his Eastern connections fortified by extensive experience in work details, as well as sales department matters.

WIRELESS CONNECTORS.—Dossert & Company, 242 West Forty-first Street, New York, have received an order for 400 solderless cable connectors from the San Francisco Gas & Electric Company. F. A. Lawson & Company, Pacific Coast agents, write that Dossert solderless connectors have been specified in the plans for the wiring of the new Palace Hotel in San Francisco.

BOOKS ON TRACTION.—The McGraw Publishing Company, 239 West Thirty-ninth Street, New York City, has just issued an envelope-size, 8-page circular or catalogue of books devoted to the subject of electric railways. Some 56 items are included ,and in each case not only are details given as to price, pages, etc., but the nature of the book is outlined. It constitutes an excellent little guide to the growing literature of the subject.

LOCKE INSULATOR COMPANY.—Mr. W. T. Goddard, electrical engineer of the Locke Insulator Company, is making an extensive trip through the Western States and thrpugh the Pacific Coast States investigating high-voltage insulator applications and transmission line and power-house design. Mr. Goddard is making a special study of the influence of various climatic conditions upon the design of insulators for various localities, especially in view of designs for 100,000 volts and higher.

THE LOCKE INSULATOR MANUFACTURING COMPANY has appointed as its agents for eastern Canada the Engineer Equipment & Supply Company, Lindsay Bldg., Montreal, Canada, which will be ready to place in the hands of engineers interested information concerning Locke product. Mr. S. W. Smith, of the above company, has long been associated with the lighting interests of Montreal, and for a considerable time was connected with the Canadian Westinghouse Company as sales engineer.

THE WEBER COMPANY.—The Weber Steel Concrete Chimney Company, of Chicago, announces that, owing to an increase of scope through taking on other kinds of plain and reinforced concrete construction work in addition to chimneys, it has been decided to change the name of the company to the Weber Company. The general offices will continue to be in the Marquette Building, Chicago. The company is now prepared to carry out contracts for all kinds of concrete and reinforced work, including foundations, walls, buildings, sewers, chimneys, etc., and already has some large contracts in these different lines under construction. The Weber Company now has branch offices in New York, Atlanta, Cincinnati, St. Louis, Houston, Memphis, Minneapolis, Denver, Salt Lake City, Los Angeles, San Francisco and Seattle, and foreign offices in London, Paris and Halle, Germany.

Weekly Record of Electrical Patents

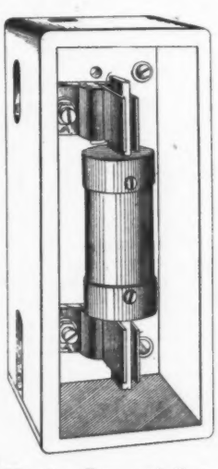
UNITED STATES PATENTS ISSUED MARCH 17, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

881,934. PROCESS OF PRODUCING ALUMINUM-MAGNESIUM ALLOYS; Franz von Kugelgen, et al., Holcombs Rock, Va. App. filed April 27, 1905. The process of producing aluminum-magnesium alloys, which consists in electrolyzing a combined fused bath of a magnesium compound and an aluminum compound.

881,938. BLOCK-SIGNAL; Don D. Miles, Jr., of Aurora, Ill. App. filed November 10, 1906. Block-signal for surface roads having an overhead trolley. Includes a special form of contact shoe suspended above the trolley wire between a pair of adjacent hangers and which closes a plurality of circuits in predetermined order.

881,943. ELECTRIC LIGHT SIGN; Mortimer Norden, of New York, N. Y. App. filed August 21, 1906. Has a box in which the lamps are received in receptacles of the ordinary sort. The lamps project through funnel-shaped openings in the cover plate, said openings flaring into the outline of the letter to be represented.



881,965.—Fuse and Fuse Box.

881,963. DISTRIBUTION FIXTURE; William D. Scott, of Buffalo, N. Y. App. filed October 7, 1907 (renewal). Has a plurality of adjustable collars with supporting strips carried thereby and projecting above and below the same, and insulators carried by the projecting parts of said strips.

881,965. FUSE AND FUSE BOX; Frank L. Sessions, of Columbus, Ohio. App. filed October 20, 1905. Makes use of a refractory box with an open side, in which are spring contacts analogous to those of a knife blade switch, between which the fuse is received.

881,967. ELECTRIC INSULATOR; Charles R. Slusser, of Montpelier, Idaho. App. filed January 30, 1907. A glass or porcelain insulator of substantially the usual form; has a V-shaped groove or slot extending diagonally inward from its upper surface and in which the conductor is received and held.

881,968. ELECTRIC KETTLE; David C. Smith, of Western Australia, Australia. App. filed July 8, 1907. Construction of tea kettle having an inner chamber communicating with one side wall of the tea kettle and in which is received a plurality of resistance elements.

881,985. PLUG SEAT SWITCH; Bernard O. Wells, of Charleston, Ill. App. filed Dec. 8, 1904. Relates to details of construction of a plug seat switch wherein the circuit connections may be made or broken by the plug of a cord circuit.

881,986. AUTOMATIC GAS ANALYZER; Henry J. Westover, of New York, N. Y. App. filed March 21, 1907. Relates to an improved form of circuit controller for use with either of a plurality of kinds of gas analysis apparatus. Includes an outer and an inner float designed to engage contact points in a predetermined sequence.

882,013. ELECTRIC SIGN OR ILLUMINATING DEVICE; William N. McComb, of New York, N. Y. App. filed Oct. 5, 1904. The lamps are received in a box, being supported by rectangular metallic strips which establish the circuit connections thereto. The strips in turn extend between bushings on longitudinally extending cross bars. In this way each lamp is movable into different relations, depending on the outline of the sign.

882,026. MEANS FOR TRANSMITTING ELECTRIC CURRENTS WITH INCREASED ENERGY; Julian A. Stratton, of Chicago, Ill. App. filed July 13, 1906. A means for transmitting electric waves or undulations and giving them increased energy in their propagation. It is particularly adapted for the "dynamo" type of Telephone Repeaters.

882,048. INDUCTION COIL; M. S. Bingham, of Detroit, Mich. App. filed Aug. 19, 1907. A construction of coil box with magnetic shields interposed between the separate coil units to prevent cross induction.

882,055. GAS LIGHTING DEVICE; William K. Elliott, of Payson, Ill. App. filed Aug. 16, 1907. A gas burner of the inverted-mantle type having circuit wires extending in proximity to the mantle and adapted to cause a jump spark through the action of a small induction coil. Includes a pneumatic apparatus for turning on the gas.

882,075. PROCESS FOR SEPARATING THE METALS CONTAINED IN COPPER-NICKEL MATTE; James M. Neil, Toronto, Ontario, Can. App. filed June 3, 1907. In a process of reducing nickel from copper-nickel matte, the electrolysis of a solution of copper-nickel sulfate with a copper-nickel anode and copper cathode to deposit the copper in the metallic form, and the treatment of the resultant nickel sulfate solution with a solution of a chlorid of an alkaline earth resulting in the formation of a solution of nickel chlorid and a precipitate of the alkaline earth.

882,089. ELECTRIC SIGNALING APPARATUS; Benjamin F. Wooding, of Denver, Colorado. App. filed Jan. 4, 1907. An apparatus for signaling between trains when the latter have approached within a given distance or have reached the same block, contacts being provided for establishing an alarm circuit by special shoes or trolleys on the trains.

882,095. WIRE TIE FOR INSULATORS; Waldo E. Callane, of Flora, Indiana. App. filed Nov. 19, 1906. A wire frame or bale adapted to be secured to an ordinary glass insulator so as to bind or tie the conductor thereon.

882,096. LIGHTNING ARRESTER; Franklin P. Cauble, of Lincolnton, N. C. App. filed May 3, 1906. Construction of ligthning arrester having a choke coil connected up in the line, and an insulated grounded conductor arranged within the coil and having a multiplicity of points extending in proximity thereto.

882,110. ANODE; A. M. Hill, of New Haven, Conn. App. filed April 15, 1907. Particular form and manner of support of electrolytic anode.

882,118. ANNUNCIATOR; John T. Needham, of Bayonne, New Jersey. App. filed May 27, 1907. Provides an annunciator or indicating device that shall be effective from both sides of a telephone switchboard. Combines with such indicator spring jack switch connections so arranged that the insertion of a plug from either side of the board or partition shall restore the indicator to its normal condition.

882,139. RESTORING ATTACHMENT TO TROLLEY WHEELS AND ELECTRIC SIGNAL FOR THE SAME; Geo. H. Brooks, of Louisville, Ky. App. filed June 17, 1907. The trolley pole has a supplemental swinging harp connected thereto, to which is journaled on elongated spool-shaped roller which serves to reposition the usual trolley on the wire.

882,141. CABLE INSULATING AND TESTING SYSTEM; Troy Cope, of New Waterford, Ohio. App. filed June 30, 1906. Has means for passing air into telephone conduits so that the inspector can tell where there is a leak by the hissing sound of the escaping air.

882,143. BLOCK SIGNAL SYSTEM; William Daves, of Bloomington, Ill. App. filed Dec. 23, 1907. Has a signal lever with an electric magnetic lock and an actuating circuit, together with means associated with the lock for completing a maintaining circuit therefor.

882,144. STORAGE-BATTERY ELECTRODE. Thomas A. Edison, of Llewellyn Park, Orange, N. J. App. filed March 30, 1905. A support for the active material of an alkaline battery, comprising a multitude of conducting metallic flakes welded together to form a cellular integral structure, substantially as set forth.

882,153. TROLLEY HEAD; James Lennox, of Brackenridge, Penna. App. filed July 24, 1907. The trolley wheel is made with the flange portions separable from the tread portion, so that the latter is removable when worn.

882,157. SAFETY APPLIANCE FOR RAILWAY TRAINS; Robley C. Millard, of Atlanta, Ga. App. filed July 17, 1907. Has a valve for venting the main pipe line controlling the brake mechanism; electric trolleys for said valve, one for opening the same to vent the main pipe line to effect a setting of the brakes, and the other to close said valve to release the brakes.

882,158. MAGNETIC ORE SEPARATOR; R. R. Moffatt, New York, N. Y. App. filed May 6, 1905. Includes a large field magnet with consequent poles between which travels a flexible belt carrying the ore which is subjected to the action of a screw while passing through the densest portion of the field so as to displace the magnetic particles.

882,169. ELECTRODE; M. Ruthenburg, of Philadelphia, Pa. App. filed Sept. 20, 1901. An electrode of the class specified, consisting of a solid mass of uniform non-ferruginous compositon, comprising silicon and carbon, capable of resisting the action of free chlorin, chlorous acid and nitric acid; said electrode being characterized by its capacity to conduct electricity through its mass, substantially as set forth.

882,186. SECONDARY ELECTRIC CLOCK; G. B. Bowell, of Westminster, London, England. App. filed Dec. 14, 1905. Has a rotary step by step operating device comprising an electromagnet with a double cam-shaped disc mounted to rotate the field thereof and actuated by the magnet when energized.

882,198. INDUCTION COIL; J. O. Heinze, Jr., of Lowell, Mass. App. filed Sept. 13, 1907. Makes use of iron plates and bodies which are disposed around the outside of a coil unit and coil box for the purpose of improving the action of the vibrator.

882,218. ELECTRIC DISCHARGE APPARATUS; P. H. Thomas, of Pittsburg, Pa. App. filed Feb. 6, 1903. An apparatus for diverting static charges of electricity from conductors of dynamic electricity to ground without disturbing the normal operation of such conductors and the machinery and apparatus connected thereto.

882,225. FLUSH RECEPTACLE; F. T. Wheeler, of Plainville, Conn. App. filed Jan. 29, 1907. A wall receptacle having a porcelain block in which is received a threaded shell, and which is attached to the rear face of a plate which fits over the opening in the wall and has a door which can be removed to expose the socket.

882,242. CROSS CONNECTION FOR DYNAMO ELECTRIC MACHINES; W. H. Foot, of Wilkinsburg, Pa. App. filed April 28, 1906. Provides an improved means for interconnecting equipotential points in the windings of dynamo electric machines that are subjected to high speeds in operation, the connections being designed to occupy a small amount of space and be protected from injury.

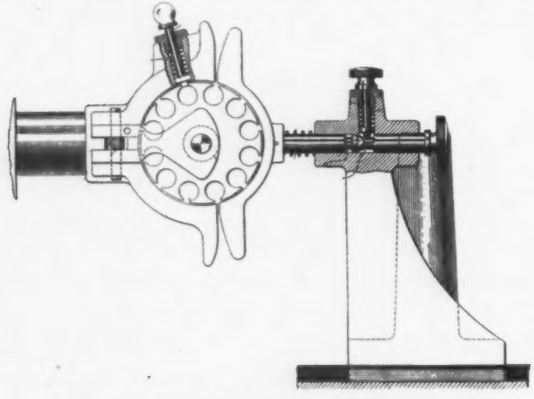
882,250. FIRE ALARM BOX; M. W. Hamblin, of Milwaukee, Wis. App. filed Feb. 27, 1902. Fire alarm box of the type designed to be placed in buildings, and from which an alarm is sent to a main receiving station. Comprises a box adapted to serve both as an alarm box and as a watchman's receiving box.

882,253. COIL WINDING MACHINE; F. R. Kunkel, of Wilkinsburg, Pa. App. filed June 12, 1905. A rotatable spindle carries a form of chuck with a circular opening in which the armature core may be inserted. The chuck has guiding ears which serve to direct the wire into the grooves of the armature when the latter is being wound.

882,257. INCANDESCENT LAMP; M. M. Merritt, of Middleton, Mass. App. filed Feb. 11, 1907. The base of an incandescent lamp is initially made with the usual threaded shell and center contact integral. These parts are spun or stamped in one piece, and are afterwards cut apart, so that they are electrically separated.

882,258. PROCESS FOR THE MANUFACTURE OF INCANDESCENT LAMP BASES; M. M. Merritt, of Middleton, Mass. App. filed May 27, 1907. The method of making the article set forth in the above patent.

882,260. SPARK PLUG CLIP; C. A. Mezger, of New York, N. Y. App. filed Sept. 6, 1906. Patentee makes use of a device having a



882,253.—Coil-Winding Machine.

pair of spring blades which engage the upper and lower sides of the thumb-nut of the spark plug.

882,265. LIGHTNING ARRESTER; N. J. Neall, of Pittsburg, Pa. App. filed Jan. 24, 1906. A lightning arrester comprising a discharge block having conducting plates secured to the faces thereof, and an apertured sheet of insulating material secured to one of the conducting plates.

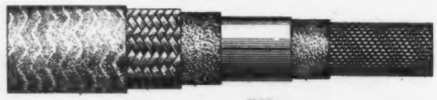
882,275. RAILWAY SIGNALING APPARATUS; J. D. Taylor, of Edgewood Park, Penn. App. filed Jan. 4, 1908. Signal system for trolley roads making use of alternating-current propulsion and using one of the track rails for the purpose of carrying the signaling current, while the other track rail carries both the power current and the signaling current. Provides means for generating a counter e.m.f. which opposes the fall of potential in the power rail which has hitherto tended to cause an element of error.

882,276. ELECTRIC SIGNALING SYSTEM; J. D. Taylor, of Edgewood Park, Penn. App. filed Jan. 30, 1908. Relates to modifications of the above.

882,292. FLEXIBLE CONDUIT; W. S. Brown, of New York, N. Y. App. filed Aug. 21, 1907. A flexible conduit adapted to lead circuit wires through the walls and ceilings of a building and protect the same from grounds and injury. Patentee makes use of a construction which has no metal in its composition, and which is very flexible laterally, and strong in a longitudinal direction. For this purpose, there are provided canvas or similar strips running longitudinally of the conduit between layers of plastic material.

882,337. JUNCTION BOX FOR ELECTRICAL CONDUITS; A. McMurtrie, of New York, N. Y. App. filed Aug. 29, 1901. A form of outlet or junction box for interior work having a square main portion with a round entering neck or channel which can be telescoped into the wall so as to suit different building constructions.

882,340. ELECTRICALLY CONTROLLED SWITCH MECHANISM; G. E. Palmer, of Boston, Mass. App. filed May 5, 1908. An electrically controlled switch mechanism for power circuits, and particularly mechanism controlled from a remote point. Has an



882,292.—Flexible Conduit.

armature or solenoid which locks the switch firmly closed and automatically breaks the energizing circuit for the switch control.

882,347. COMPOSITE SIGNALS AND TELEPHONE SYSTEM; Harry O. Rugh, of Sandwich, Ill. App. filed June 14, 1906. Details of circuits and connections.

882,378. DRINKING VESSEL; E. Friendlich, of New York, N. Y. App. filed Jan. 23, 1907. A drinking cup having a push button in the handle which completes a circuit through the body of the fluid contained in the cup.

882,388. ELECTRIC OIL SWITCH; J. D. Hilliard, et al., of Glens Falls, N. Y. App. filed Jan. 29, 1906. Oil bath switch having one contact plate supported by an insulator in submerged relation, and another swinging knife-blade element which is abruptly moved by mechanism on the outside of the box.

882,394. CONTACT APPARATUS FOR ELECTRIC IGNITERS; J. Krannichfeldt, of Cologne, Germany. App. filed Dec. 16, 1905. Has a multiplying gear and a centrifugal device for closing the circuit when the speed of the generator has attained a predetermined value.

882,417. PROCESS OF PRODUCING FERROSILICON; Edgar F. Price, of Niagara Falls, N. Y. App. filed Nov. 14, 1905. The continuous process of producing ferrosilicon, which consists in smelting a charge containing a silicon compound, carbon and a source of iron, by means of an electrically-heated resistance conductor, with drawing the molten product from the furnace, and supplying the charge-mixture as required, as set forth.

882,418. PROCESS OF PRODUCING SILICO-SPIEGEL; Edgar F. Price, of Niagara Falls, N. Y. App. filed Nov. 14, 1905. The continuous process of producing silico-spiegel, which consists in smelting a charge containing compounds and manganese and silicon, carbon and a source of iron, by means of an electrically-heated resistance conductor, withdrawing the molten product from the furnace, and supplying the charge-mixture as required, as set forth.

882,424. INSULATOR PIN; W. Scharfhausen, of Payette, Idaho. App. filed June 10, 1907. A device for securing an insulator pin within the cross arm of a telegraph pole, comprising a groove which receives a nail and deflects the latter outwardly into the wood of the cross arm. The nail is afterwards bent over to hold the pin in place.

882,450. TROLLEY; F. E. Brazeal, of Monson, Mass. App. filed June 15, 1907. A form of trolley wheel having a pair of annular chambers, with oil rings therein, for lubricating purposes.

882,495. TROLLEY CAR POLE ATTACHMENT; G. R. Dunn, San Diego, Cal. App. filed Aug. 30, 1906. The trolley harp is pivoted to the pole on an inclined axis in the plane of the trolley wheel. The wheel is held in comparatively rigid relation by a chain connection, but is capable of slight lateral movement through the resiliency of the chain.

882,498. PROTECTIVE APPLIANCE FOR ELECTRIC CIRCUITS AND APPARATUS; H. H. Hornsey, et al., Chicago, Ill. App. filed Dec. 19, 1901. Relates to protective appliances for electric circuits employing tubular or other coverings for fuse wire, together with signaling means to indicate the condition of the fuse wires or links within the tubes or sheaths.

882,508. STATIC INFLUENCE ELECTRIC MACHINE; H. Wommelsdorf, Charlottenburg, Germany. App. filed April 27, 1906. A construction of the sectors of a Wimshurst static machine, in which the sectors are embedded in layers of insulating material so as to be separated from one another, but each has a stud projecting out for engagement with the brushes.

882,509. APPARATUS FOR PRODUCING OZONE; A. C. Wood, Philadelphia, Pa. App. filed Oct. 1, 1904. Has a pair of concentric tubes, between which the air current flows, being subjected to a brush discharge between the tubes at different points along their lengths.

882,510. APPARATUS FOR PRODUCING OZONE; A. C. Wood, Philadelphia, Pa. App. filed May 12, 1906. Relates to modifications of the above.

882,514. CONNECTION FOR ELECTRIC CONDUCTORS; F. O. Ball, Plainfield, N. J. App. filed Jan. 31, 1906. A spring clip having a pair of holes which can be made to register and engage over the usual threaded terminal studs of a dry battery. The resiliency of the springs throws them out of register and clamps the studs.

882,523. BLOCK SIGNAL SYSTEM; F. E. Kinsman, Plainfield, N. J. App. filed Nov. 29, 1904. The track rails are made sectional throughout their length for signaling circuit purposes, and the power conductors are arranged in a special way so as to be separated by a considerable distance, whereby the danger to persons walking on the track is minimized.

882,531. ROTARY CONVERTER; J. L. Murdock, Bound Brook, N. J. App. filed March 28, 1906. A rotary converter for three-phase alternating currents, accumulating predetermined portions of such currents in such a manner as to accumulate the effects of the portions thus selected, and thus build up a virtually direct current which is practically constant.